THE PHILIPPINE
JOURNAL OF SCIENCE

VOL. 69 JUNE, 1939 No. 2

NEUROPTEROID INSECTS FROM THE PHILIPPINES

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ONE PLATE

Prof. L. B. Uichanco, of the University of the Philippines, sent me a number of neuropteroids for determination. Many were collected by various students, and a considerable number by Professor Uichanco and by Dr. C. S. Banks; a few were from the late Prof. C. F. Baker. I have added descriptions of a few new species from the Baker and Clagg material that had not been studied. Much of the material I received from Professor Baker had no dates of capture, so I have given the records with dates from Professor Uichanco's material, in which nearly everything was dated, at least to the month.

EMBIIDÆ

OLIGOTOMA SAUNDERSI Westwood.

NEGROS, Occidental Negros, La Carlota Central, March, 1930 (*L. B. Uichanco*).

OLIGOTOMA MASI Navas.

LUZON, Laguna Province, Los Baños, January 3, 1930 (*M. Plurad*), March 1, 1931 (*D. Tabije*), November 11, 1931 (*R. Base*).

PSOCIDÆ

PSOCUS BAKERI Banks.

LUZON, Laguna Province, Los Baños, January 21, 1935 (*G. A. Pangga*); Pili River, Mount Maquiling, altitude 80 meters,

February 19, 1924 (*D. Sulit*); Ilocos Norte, Paoay, December 28, 1931 (*F. Villanueva*).

PSOCUS OMISSUS sp. nov.

Similar to *P. lemniscatus*, apical marks similar, subbasal band wanting; only a black spot over basal part of radial sector, a black spot across anal cell near end; median cell only a little longer than broad, third median scarcely two and one-half times as long as broad, third median cell about as in *P. lemniscatus;* lower branch of radial sector separating from upper in a broad curve, which is here hyaline; lower end of median cell pale. Head, notum, and eyes as in *P. rizali;* hairs on male antennæ six to eight times the width of a joint.

MINDANAO, Mount Apo, Tia Ridge, altitude 6,000 feet, September (*Clagg*); Subulan River, October 11, altitude 2,000 feet (*Clagg*). Smaller specimens from Luzon (*Clagg*) and Samar (*Baker*). Two males lack the brown color in the third median cell. Type, M. C. Z. No. 22977.

PSOCUS RIZALI sp. nov.

In general similar to *P. lemniscatus* Enderlein, and formerly identified by me as that species. Differs from *lemniscatus* in having a nearly square median cell, in the much broader third median cell, and in a much more elongate second median cell. The subbasal band is broader than in *lemniscatus*, and there is a curved dark mark in the radial cell; both sexes marked the same. Head almost wholly pale, nasus bulging out in front; hairs of antennæ in female only a little longer than width of joint, in male fully four or five times as long; eyes of male not enlarged; notum shiny brown to nearly black, sutures scarcely marked with pale, subbasal band on hind margin reaching to base of wing (in *P. viscayana* broken long before base).

Lower branch of radial sector separating from upper in a broad curve, and here hyaline white; lower end of median cell also hyaline.

Length of forewing, female, 7 millimeters; male, 5.

Various specimens from Mount Maquiling, Luzon, and from Samar (21077), both collected by Baker. Type, M. C. Z. No. 22976.

PSOCUS ILLOTUS sp. nov.

Head dull gray, darker on clypeus and nasus; notum brown, sutures pale. Forewings with apical markings much as in *Psocus murudensis* Karny, but more extended. Stigma dark,

a spot behind angle of stigma extending across radial area and down on posterior side of areola postica to margin, two other spots in radial area, the one at tip pale in the middle, a spot at end of upper branch of radial sector, each of posterior cells margined along sides with dark, second cell with a band across a little below medius, also a spot at nodus and basal part of radial sector. Broad dark band over basal part of wing in *P. murudensis* wholly lacking in this species.

Wing rather slender, median cell much longer than broad, areola postica with a short top on medius (very long in *murudensis*), branches of radial sector separating in an acute angle. Hair on male antenna fully three to four times as long as width of a joint.

Length of forewing, 3.5 millimeters.

LUZON, Mountain Province, Benguet Subprovince, Baguio, July 10 (*McCoy*). Type, M. C. Z. No. 22978.

STENOPSOCUS JOCOSUS sp. nov.

Head pale, nasus and clypeus slightly brown in the middle, a black band from eye to eye through ocelli, antennæ (female) very pale, scarcely at all marked. Legs pale; notum with three large shiny black spots. Forewings with elongate stigma hyaline, an even broad black line along posterior margin of stigma, crossvein behind longer than width of stigma; lower side of median cell about twice as long as crossvein to medius, second branch of medius about parallel to posterior side of areola postica; separation of radial sector and medius hyaline for a short distance. Veins with few hairs, each about its length from next, hairs around outer margin few, very short, inconspicuous. Eyes (female) two diameters apart.

A male, which may belong here, has the eyes a little more than one diameter apart, the antennæ black, the stigma yellowish, and tips of femora and tibiæ dark.

Length of forewing, 4.2 millimeters.

From Basilan, and Zamboanga Province, Mindanao (*Baker*); male from Calian, Davao Province, Mindanao, July 11 (*Clagg*). Type, M. C. Z. No. 22979.

CÆCILIUS MUGGENBERGI Enderlein.

Nathanopsocus fuscolineatus C. S. Banks is a synonym; accession No. 18338.

AMPHIPSOCUS UNITUS Banks.

LUZON, Laguna Province, Los Baños, June 17; December 26, 1925 (*S. S. Gonzales*).

TAGALOPSOCUS HYALINUS Banks.

LUZON, Laguna Province, Mount Banahao (Kinabuhayan), May 21, 1933 (*V. J. Madrid*).

DYPSOCUS APICATUS Banks.

LUZON, Laguna Province, Los Baños, July 7, 1923 (*S. M. Cendaña*), June 2, 1918 (*C. S. Banks*).

HEMIPSOCUS ROSEUS Hagen.

LUZON, Laguna Province, Los Baños, June 15, 1932 (*S. R. Capco*).

LOPHOPTERYGELLA CAMELINA Enderlein.

LUZON, Laguna Province, Los Baños, September 27, 1915 (*C. S. Banks*); Laguna Province, Calauang, September 5, 1922 (*L. B. Uichanco*).

PERLIDÆ

NEOPERLA RECTA Banks.

LUZON, Laguna Province, Mount Maquiling, August 28, 1925 (*H. Protacio*); Los Baños, November 20, 1915 (*C. S. Banks*), February 15, 1931 (*Isabelo Monje*), October 12, 1929 (*F. Villanueva*), August 25, 1923 (*J. R. Bogayong*), November 19, 1930 (*E. Cada*), August 4, 1929 (*V. Villafranca*), June 23, 1925 (*U. Villar*).

NEOPERLA PALLICORNIS Banks.

LUZON, Laguna Province, Los Baños, January 3, 1932 (*M. Plurad*), February 3, 1925 (*F. Goseco*).

NEOPERLA VISCAYANA Banks.

LUZON, Laguna Province, Los Baños, March 1, 1931 (*D. Tabije*).

NEOPERLA OBLIQUA Banks.

LUZON, Laguna Province, Los Baños, October 29, 1916 (*F. B. Padolina*), January 11, 1917 (*T. Nisce*), January 8, 1917 (*C. R. Paulinan*) January 16, 1917 (*C. S. Banks*), June 1, 1914 (*E. Ejercito*), August 6, 1923 (*E. M. Sibal*), August 23, 1931 (*G. B. Viado*), March 1, 1931 (*D. Tabije*), July 21, 1927 (*P. Ungos*).

PHANOPERLA CLARISSA Banks.

LUZON, Laguna Province, Los Baños, January 26 and 29, 1915 (*C. S. Banks*), February 10, 1932 (*M. Plurad*), June 15, 1915 (*C. S. Banks*), August 8, 1923 (*P. V. Maclang*), September 18, 1929 (*S. M. Cendaña*), February 20, 1917 (*G. D. Cazeñas*), August 5, 1923 (*G. Guanzon*).

MINDANAO, Dansalan, altitude 300 feet, April 27, 1936 (*L. B. Uichanco*).

PHANOPERLA CONSIMILIS Banks.

LUZON, Laguna Province, Los Baños, June 1, 1915 (*C. S. Banks*), August 5, 1923 (*G. Guanzon*).

PHANOPERLA BAKERI Banks.

LUZON, Laguna Province, Los Baños, July 17, 1927 (*P. H. Viray*).

NOTHOCHRYSIDÆ (CHRYSOPIDÆ)

NOBILENUS BELLULUS Banks.

LUZON, Laguna Province, Los Baños, May 8, 1923 (*L. B. Uichanco*), July 10, 1923 (*F. S. Manipol*), December 26, 1930 (*M. Plurad*).

NOTHOCHRYSA EVANESCENS McLachlan.

LUZON, Laguna Province, Los Baños, July 11, 1930 (*C. Bagalso*), August 25, 1929, entom. student, September 9, 1915 (*C. S. Banks*), October 30, 1930 (*E. Lantin and V. Juan*); Mount Maquiling, altitude 285 meters, August 21, 1932 (*V. Asuncion*).

NOTHOCHRYSA ÆQUALIS Walker.

LUZON, Laguna Province, Los Baños, June 29, 1932 (*A. Y. Coronel*), July 9, 1922 (*S. Lantican*), July 9, 1927 (*H. T. Ramos*), October 15, 1928 (*E. A. Lanuza*).

ANKYLOPTERYX TRIPUNCTATA Girard.

LUZON, Laguna Province, Los Baños, August 19, 1926 (*Mrs. I. R. Cendaña*).

ANKYLOPTERYX BORNEENSIS Weele.

LUZON, Laguna Province, Los Baños, March, 1930 (*J. Abrenica*), December 23, 1930 (*E. Dumaguing*).

ANKYLOPTERYX NERVOSA Navas.

LUZON, Laguna Province, Los Baños, July 8.

CHRYSOPA ISOLATA Banks.

LUZON, Laguna Province, Los Baños, April 22, 1930 (*G. B. Viado*), August 15, 1915 (*H. Cuzner*).

CHRYSOPA MOROTA Banks.

LUZON, Laguna Province, Los Baños, May 21, 1923 (*S. M. Cendaña*).

CHRYSOPA MAKILINGI Banks.

LUZON, Laguna Province, Los Baños, April 21, 1930 (*V. J. Madrid*), Tolim, May 3.

CHRYSOPA ILOTA Banks.

LUZON, Laguna Province, Los Baños, July 7, 1921 (*M. Jaramila*).

CHRYSOPA TAGALICA Banks.

LUZON, Mount Banahao, crater, April 24, 1936 (*V. J. Madrid*).

CHRYSOPA NIGRIBASIS Banks.

LUZON, Laguna Province, Los Baños, March 15, 1915 (*C. S. Banks*).

CHRYSOPA (BORNIA) LUZONICA sp. nov.

Head pale yellowish, with a slight tint of reddish on vertex, no dark on cheeks; palpi pale, unmarked; antennæ pale; pronotum also pale, in one specimen with a faint median reddish streak, and more faint back on mesonotum; abdomen and legs pale.

Wings hyaline; venation pale, gradates brown, some radial crossveins and a few veins toward base of wing faintly brownish. In hind wings veins wholly pale.

Antennæ about two-thirds length of forewings; pronotum longer than broad behind, somewhat tapering forward. Wings rather slender, tips almost acute. In forewings radial sector but little curved; three series of gradates, eight in first, four or five in intermediate, eight in outer row; divisory veinlet ending just beyond crossvein; seven cubitals beyond it; twelve radial crossveins. In hind wing six inner and eight outer gradates, inner row rather nearer to radial sector than to outer row.

Length of forewing, 14.5 millimeters; width, 5.

LUZON, Laguna Province, Mount Banahao, in crater, April 22; altitude 974 meters, April 21 (*V. J. Madrid and G. T. Lim*).

Types in the College of Agriculture, University of the Philippines Collection, and M. C. Z. No. 23333.

OSMYLIDÆ

SPILOSMYLUS MODESTUS Gerstaecker.

LUZON, Laguna Province, Los Baños, June 15, 1932 (*A. Y. Coronel*).

MICROMIDÆ (HEMEROBIIDÆ)

ARCHÆOMICROMUS PUSILLUS Gerstaecker.

LUZON, Laguna Province, Los Baños, July 10, 1923 (*C. Crucillo*), September 15, January 5. MINDANAO, Lanao Province, Dapao Lake, Ganassi, altitude 3,000 feet, April 28, 1936 (*L. B. Uichanco*).

ARCHÆOMICROMUS IGOROTUS Banks.

LUZON, Laguna Province, February 17, 1923 (*G. B. Ingalla*).

MYRMELEONIDÆ

MYRMELEON CELEBESENSIS McLachan.

LUZON, Laguna Province, Los Baños, August 1, 1923 (*J. Barsana*), September 8, 1924 (*C. G. Manuel*), February 22, 1932 (*A. Palma*).

MYRMELEON ANGUSTIPENNIS Banks.

LUZON, Laguna Province, Los Baños, January 20, 1923 (*S. J. Aquino*), July 2, 1917 (*C. S. Banks*), July 4, 1923 (*L. Salazar*), November 1, 1931 (*M. Cera*), December 27, 1924 (*D. Suerte*).

HAGENOMYIA SAGAX Walker.

LUZON, Laguna Province, Los Baños, July 24 1918 (*C. S. Banks*).

DISTOLEON CLEONICE Banks.

LUZON, Laguna Province, Los Baños, August, 1926 (*C. Sundarasinha*), July 24, 1932 (*A. Barroquillo*), June 2.

NUGLERUS INSIGNIS sp. nov.

Head pale, a brown line below and one above antennæ; vertex with a transverse brown mark on each side, narrowly connected in the middle; palpi pale; antennæ pale, tips a little darker. Pronotum pale, on posterior part lateral margins broadly brown, on anterior part, sides and front margin faintly dark; long black hairs in front and some behind groove, shorter, curved; paler hairs on sides; mesonotum with brown spots, usually connected; metanotum more brown, tip of metascutellum shiny dark brown; on mesonotum very long erect black hairs, mostly in two groups on each side. Legs pale, base and tips of tibiæ darker, front coxæ long, with a broad, oblique, brown mark on outer side; spurs slender, curved near tips, equal to two joints; basal tarsal joint a little longer than apical joint, claws fully one-half of last joint; pleura with a brown stripe. Wings shaped as in other species (*scalaris* and *maculata*), tip of forewing hardly as acute as in *maculata;* a large bulla near tip of each pair.

Forewing with apical bulla brown, a smaller brown cloud over rhegma, and one on hind margin at end of anal vein. Between subcosta and radius thirteen brown spots (as usual), between each pair two or three brown spots from subcosta, not reaching across; in mediocubital area nine crossveins before and fourteen beyond stigma, these crossveins brown and more or

less bordered with brown; venation brown, in cubital area and anal area more pale; subcosta, radius, and cubitus interrupted with pale; hairs on veins moderately long. On hind wing apical bulla dark brown, a faint mark over rhegma; venation mostly brownish, paler in middle of apical half behind. Venation much as in other species; costals toward stigma forked; eight radial sectors; four crossveins before radial sector in forewing, two in hind wing.

Length of forewing, 28 milimeters; hind wing, 30.

LUZON, Laguna Province, Mount Maquiling (*C. F. Baker*). Type M. C. Z. No. 23020.

Readily separated from *scalaris* by more numerous marked veins in mediocubital area; from *maculata* (*Bofia*) separated by lack of middle dark spot near tip, by pale front (black in *maculata*), by single stripe on pleura (two parallel lines in *maculata*); femora pale above (with dark line in *maculata*).

The genus is peculiar in that there is no branch of the cubitus in the hind wing that can be identified as the cubital fork, the anal vein apparently continuing as a zigzag line; this postcubital area extremely narrow, mostly 1-celled.

ASCALAPHIDÆ

SUBPALASCA PRINCEPS Gerstaecker.

LUZON, Laguna Province, Mount Maquiling, April 16, 1930 (*V. J. Madrid*), June 15, 1931 (*Emilio Ocampo*).

MANTISPIDÆ

EUCLIMACIA GUERINI Westwood.

LUZON, Laguna Province, Los Baños, February 10, 1929 (*L. B. Uichanco*); Mount Maquiling, July 22, 1925 (*Entomology student*).

EUMANTISPA STRENUA Gerstaecker.

LUZON, Nueva Ecija Province, Bongabon, December 26, 1934 (*Angel Huertas*).

CLIMACIELLA LUZONICA Weele.

LUZON, Laguna Province, Los Baños, August 6, 1923 (*E. M. Sibal*).

MANTISPA LUZONENSIS Navas.

LUZON, Laguna Province, Los Baños, October 27, 1933 (*T. Araneta*); Mount Maquiling, altitude 92 meters, June 16, 1932 (*V. J. Madrid*).

MANTISPA ENDERLEINI Banks.

LUZON, Laguna Province, Los Baños, June 11, 1917 (*C. S Banks*), October 27, 1933 (*T. Araneta*).

AUSTROMANTISPA MANCA Gerstaecker.

LUZON, Laguna Province, Los Baños, April 9, 1926 (*C. G. Manuel*), June 2, 1923 (*S. M. Cendaña*).

RHYACOPHILIDÆ

AGAPETUS CURVIDENS Ulmer.

MINDORO, Mindoro Province, April 11 and 12, 1923 (*L. B. Uichanco*).

HYDROPSYCHIDÆ

VIGARBHA TIBIALIS Navas.

LUZON, Laguna Province, Los Baños, March 17, 1915, many specimens (*C. S. Banks*), August, 1927 (*L. B. Uichanco*). NEGROS, Occidental Negros Province, La Carlota Central, March, 1930 (*L. B. Uichanco*). MINDANAO, Surigao Province, April 20, 1936 (*L. B. Uichanco*).

DIPSEUDOPSIS BAKERI Banks.

LUZON, Laguna Province, Los Baños, very common, every month of year, February 25, 1924 (*A. Damian*), June 14, 1915 (*C. S. Banks*), July 12, 13, and 19, 1922 (*L. B. Uichanco*), July 15, 1915 (*C. S. Banks*), July 22, 1922 (*S. Pagcaliuag*), September 5, 1915 (*G. C. Zabella*), September 30, 1915 (*J. Trinidad*), October 4, 1930 (*A. Siason*), October 8, 1931 (*M. Legaspi*), December 3, 1930 (*C. Valdez*).

DIPSEUDOPSIS NERVOSA Brauer.

LUZON, Laguna Province, Los Baños, April 8, 1917 (*L. G. Mendoza*), July 2, 1923 (*G. B. Ingalla*), November 5, 1924 (*A. Muyargas*).

DIPSEUDOPSIS LUCTUOSA Banks.

MINDANAO, Agusan Province, Jabonga, Mayogda, April 21, 1936 (*L. B. Uichanco*). LUZON, Laguna Province, Los Baños, August 24, 1915 (*F. W. Ashton*), November 14, 1924 (*M. Tadle*), December 16, 1923 (*E. Quisumbing*).

POLYPLECTROPUS ULMERI Banks.

LUZON, Laguna Province, Los Baños, March 17, 1915 (*C. S. Banks*), May 10, 1915 (*C. S. Banks*), June 28, 1922 (*L. B. Uichanco*).

DIPLECTRONA FASCIATA Ulmer.

LUZON, Laguna Province, Los Baños, April 15, 1923 (*G. Lacuesta*).

DIPLECTRONA COSTALIS Banks.

LUZON, Laguna Province, Los Baños, March 17, 1915 (*C. S. Banks*), July 11, 1923 (*T. Reveche*).

CHEUMATOPSYCHE MASIA Navas.

LUZON, Laguna Province, Los Baños, July 13, 1925 (*F. Reveche*), August 12, 1923 (*J. M. de Vera*), September 8, 1917 (*C. S. Banks*), September 20, 1925 (*G. C. Bermejo*), October 191– (no other data). NEGROS, Occidental Negros, La Carlota Central, March, 1930 (*L. B. Uichanco*).

ECNOMUS TAGALENSIS Banks.

This neuropteroid was described as a *Nyctophylax*, and *Ecnomus viganus* Navas is the same species. It is fairly common in Luzon. Superior appendages long, cylindrical, subparallel, with stout, short bristles on inner side; inferior appendages a little more than one-half as long as superior, broadened toward base, toward tip incurved and pointed.

Ulmer has based an identification of a different species on a drawing sent to Navas. But Navas in his original description says that the superior appendages are long, cylindrical (while the figure of Ulmer does not show such an appendage), that the inferior appendages are also elongate, dilated near the base, and toward tip plainly attenuate and clawlike (Ulmer's figure shows a short, broad appendage, broad at tip, not at all attenuate).

I propose for the species Ulmer called *E. viganus* the name *Ecnomus morotus*. Mindanao.

ECNOMUS RIZALI Banks.

LUZON, Laguna Province, Los Baños, May 21, 1923 (*S. M. Cendaña.*)

POLYMORPHANISUS SEMPERI Brauer.

LUZON, Laguna Province, Mount Maquiling, altitude 600 meters, April 19, 1937 (*V. J. Madrid*); Los Baños, October 30, 191— (*G. D. Cazenas*).

GUNUNGIELLA MARGINALIS sp. nov.

Hair on head and thorax gray; antennæ pale, darker toward tip, more or less annulate with dark; legs and spurs pale. Forewings in appearance whitish through middle, margined with deep black fringe along costa and outer border, behind with gray fringe. Middle of wing with fine yellowish and black hair, just before outer margin a band of golden hair, and a black fringe around outer margin, elsewhere gray. Head with large, high, posterior warts, ocelli and palpi as in other species. Wings slenderer than in *G. reducta* or *G. nietneri;* thus lower side of fork five hardly one-fourth as long as upper side; in hind wings noticeably more slender and more pointed; fork five larger, fork two longer.

Length of forewing, 4 millimeters.

MINDANAO, Davao Province, Mount Mayo, January 26, 1929, 4,000 to 5,000 feet (*C. S. Clagg*).

Type, M. C. Z. No. 23195.

PSYCHOMYIELLA ULMERI sp. nov.

Head with pale grayish hair, basal joint of antennæ dark, beyond pale, faintly annulate with dark, antenna from middle to tip dark. Front of thorax with pale-gray hair; legs and spurs pale; abdomen dark. Forewings gray, with black and golden hair, fringe near tip of wing very dark, veins here almost black, fringe behind pale, on costa almost black; hind wings gray, with long gray fringe, that on apical half of costa also long and more yellowish. Venation much as in other species; fork three slenderer, fork four very large, fork five plainly shorter than four, lower side not one-half as long as upper side. Hind wings much as in *P. minima*, very slender, apical half (beyond projection) more than twice as long as width at projection; upper side of fork five fully three times as long as lower. In female tip of ovipositor forked; in male lower appendages long, nearly straight.

Length of forewing, 4.2 to 4.5 millimeters.

MINDANAO, Galog River, Mount Apo, altitude 6,000 feet, October 8 and 19, November 4 and 5; Mainit River, altitude 6,000 feet, September 22 and 23, 1929. All collected by C. S. Clagg. Type, M. C. Z. No. 23194.

PADUNIELLA ANGUSTA sp. nov.

Head and thorax with gray hair, some black on sides, antennæ pale, faintly annulate with dark; legs pale, spurs pale; abdomen black. Forewings gray, with some dark and much golden hair, rather darker towards tip; fringe very long, gray, but toward tip nearly black; hind wings pale gray, with very long gray fringes. Forewings rather more slender than in *semarangensis* or *borneensis;* fork three shorter, discal cell shorter. In hind wing base fairly broad, two clear areas broader than in other species, and I cannot find any vein parallel to the base of fork five, but this vein is rather heavy. In the clear costal space a spur vein, much as in *P. africana*. Male appendages yellowish, two long, slender, slightly curved lower pieces, above with a rather broad superior plate, between a pair of slender pieces swollen toward tips; from above projects below a broad, recurved, pointed process.

Length of forewing, female 2.8 millimeters; male, 2.6.

MINDORO, Mindoro Province, San Jose, April 11, 1923 (*L. B. Uichanco*). Type, M. C. Z. No. 23196; paratypes in the College of Agriculture, University of the Philippines.

CALAMOCERATIDÆ

ANISOCENTROPUS MAGNIFICUS Ulmer.

LUZON, Laguna Province, Los Baños, February 26, 1931 (*Gironello*), May 10, 1926 (*S. C. Cendaña*), August 5, 1915 (*L. B. Uichanco*). BASILAN, May 6, 1936 (*Uichanco*).

LEPTOCERIDÆ

NOTANATOLICA GILOLENSIS McLachlan.

LUZON, Laguna Province, Los Baños, many specimens, in every month of the year, but few in August and December, February 10, 1931 (*A. Costes*), April 23, 1928 (*L. B. Uichanco*), June 18 and 23, 1915 (*C. S. Banks*), July 20, 1915 (*C. S. Banks*), July 30, 1922 (*P. Masibay*), August 24, 1915 (*F. W. Ashton*), September 22, 1915 (*C. S. Banks*), October 25, 1915 (*C. S. Banks*), November 14, 1930 (*P. Elayda and R. Denoga*), February 24 (*C. T. Buligan*).

NOTANATOLICA GRISEA Banks.

LUZON, Laguna Province, Los Baños, January 1, 1915 (*J. P. Esguerra*), March 1, 1931 (*D. Tabije*), July 20, 1922 (*A. Gordon*), September 2, 1928 (*A. Severino*), December 16, 1925 (L. *B. Uichanco*).

ŒCETIS APICIPENNIS Banks.

LUZON, Laguna Province, Los Baños, August 15, 1915 (*C. S. Banks*), September 6, 23, and 27, 1915 (*C. S. Banks*).

SETODES SPINOSELLA Ulmer.

NEGROS, Occidental Negros Province, La Carlota Central, March, 1930 (*L. B. Uichanco*).

ŒCETINELLA CONFLUENS Ulmer.

LUZON, Laguna Province, Los Baños, October 25, 1922 (*L. B. Uichanco*).

SERICOSTOMATIDÆ

GŒRA LONGISPINA Ulmer.

LUZON, Laguna Province, Los Baños, December 15, October 17, 1915 (*C. S. Banks*).

GŒRA TAGALICA Banks.

LUZON, Laguna Province, Los Baños, September 20, June 29, 1915 (*C. S. Banks*).

ILLUSTRATION

PLATE 1

FIG. 1. *Psocus rizali* sp. nov.; forewing.
2. *Psocus illotus* sp. nov.; forewing.
3. *Paduniella angusta* sp. nov.; male genitalia, side.
4. *Gunungiella marginalis* sp. nov.; hind wing.
5. *Paduniella angusta* sp. nov.; fore and hind wings.
6. *Paduniella angusta* sp. nov.; male genitalia, below.
7. *Ecnomus tagalensis* sp. nov.; male genitalia, above and below.
8. *Psychomyiella ulmeri* sp. nov.; hind wing and part of forewing.
9. *Stenopsocus jocosus* sp. nov.; forewing.
10. *Psychomyiella ulmeri* sp. nov.; male genitalia, side.

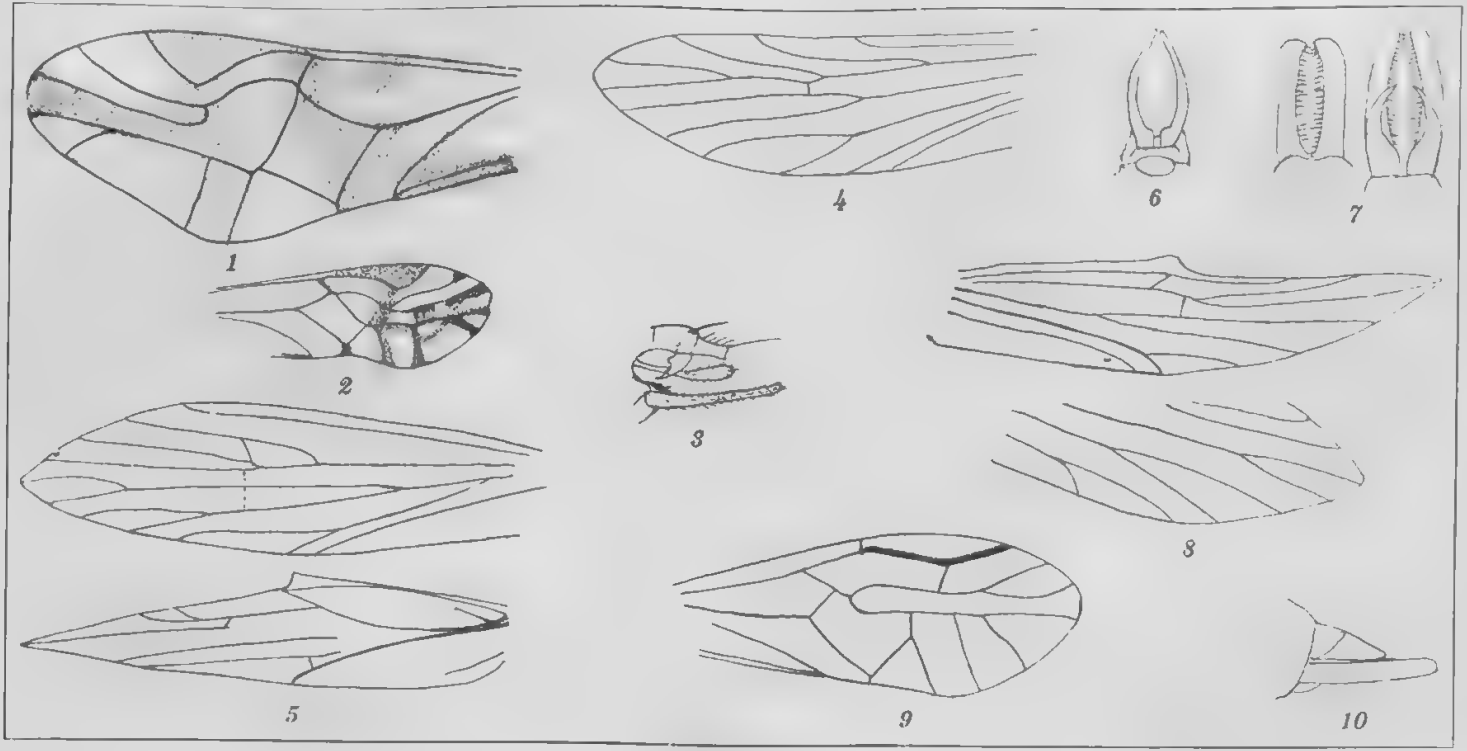

PLATE 1.

A CONTRIBUTION TO OUR KNOWLEDGE OF GORPIS STÅL (HEMIPTERA: NABIDÆ)

By H. M. HARRIS
Of Ames, Iowa

ONE TEXT FIGURE

In a former paper [1] I pointed out some of the difficulties one meets in attempting to identify specimens of the genus *Gorpis* Stål, and presented a catalogue of the species. Through the kindness of the authorities of the British Museum of Natural History, and especially of Mr. W. E. China, it now becomes possible to make a further contribution to our knowledge of the group.

GORPIS LONGISPINIS sp. nov.

Pale, yellowish testaceous tending toward orange; basal two antennal segments, femora toward apex, and tibiæ toward base flecked or tinged with orange-red; disc of hind lobe of pronotum, scutellum, and median longitudinal stripe to tip of hemelytra darker; humeral spines piceous black above. Head, measured to collum, one-half longer than broad (30: 21), length of anteocular part measured to apex of antenniferous tubercule slightly greater than width of eye; vertex wide (10). Eye proportions, length : width : depth, 9 : 5.5 : 8. Antennal formula 62 : 80: 77: 33; segment I stout, thickly clothed with long, rather coarse, obliquely rising hairs whose length is about three times diameter of segment, segment II with equally numerous but distinctly shorter hairs. Rostral formula, 27: 24: 12. Pronotum longer than broad (49: 41); collar long (5), indistinctly but coarsely punctate; front lobe small, as long as broad (19); hind lobe prominently raised above front lobe, sharply expanded laterally, very thickly, coarsely punctate, humeri armed with a long tapering horn which projects obliquely outward and upward. Scutellum small, slightly broader than long (15: 14), not noticeably produced at apex. Hemelytra narrow, extending beyond apex of abdomen, claval commissure short (25). Ante-

[1] Philip. Journ. Sci. 43 (1930) 415.

rior legs as seen from side rather slender, coxa about three times as long as thick (34: 11), femur nearly ten times as long as deep (96: 10). Male clasper as in text fig. 1, *e*.

Length, 11.8 millimeters; width, 1.81.

Holotype, male, India, United Provinces, Naini Tal, 6,400 feet, April 7, 1934 (*J. A. Graham*); in the collection of the British Museum of Natural History.

This form seems nearest *acutispinis* Reuter and *humeralis* (Distant), and belongs to the same section of the genus. From Reuter's description of the former it differs in color, in that

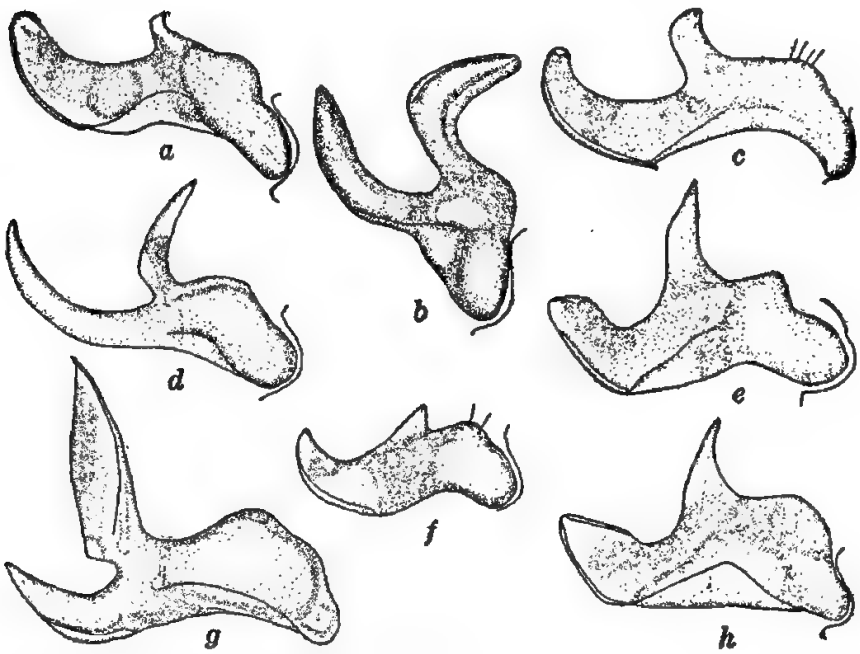

FIG. 1. Left clasper of males of various species of *Gorpis*. *a*, *Gorpis papuanus* sp. nov.; *b*, *G. clavatus* sp. nov.; *c*, *G. simillimus* sp. nov.; *d*, *G. chinai* sp. nov.; *e*, *G. longispinus* sp. nov.; *f*, *G. neglectus* sp. nov.; *g*, *G. transvaalensis* Schouteden; *h*, *G. rufinervis* Poppius.

antennal segment I is equal in length to pronotum and scutellum combined, the pronotum is distinctly longer than broad, and the fore femur is distinctly longer than pronotum and clavus taken together. It agrees with Distant's description and figure of *humeralis* in the proportional length of antennal segment I and in the nature of the antennal clothing, but differs in that the humeral spines are much longer and sharper; there is no evidence of a transverse fascia on the hemelytra, and the front coxæ are longer and their acetabula more inflated.

GORPIS TRANSVAALENSIS Schouteden.

Gorpis transvaalensis SCHOUTEDEN, Rev. Zool. Afr. 6 (1919) 241.

Head longer than broad (male, 31:20), vertex broad (10). Eyes small, length distinctly less than width of vertex, 8:5:7. Antennæ long, segment I relatively thin along basal third, then rather suddenly and noticeably thickened, clothed with a few moderately long pale hairs, 44:52:58:29. Pronotum as long as broad (41:41), anterior lobe distinctly margined laterally, its disc with cicatrices shiny, darkened, and quite conspicuous; posterior lobe barely raised above anterior, very thickly coarsely punctate, punctures very irregular in size, base deeply emarginate in front of scutellum, margin of the prolonged part on each side of scutellum slightly reflexed. Scutellum as broad as long. Costal margin of hemelytra strongly sinuate. Front coxæ relatively short and stout, less than three times as long as thick (28:11). Anterior femur only about six times as long as deep (78:13). Abdomen strongly widened at middle, connexivum prominently maculate. Male clasper as in text fig. 1, *g*.

SOUTH AFRICA, East Cape Province, Kathberg, 4,000 feet, 8 specimens, October, 1932 (*R. E. Turner*); Natal, Malvern, 1 specimen, May 26, 1897 (no collector); Durban, 1 specimen, 1897 (no collector); 1 specimen, 1903 (*W. H. Bell Marley*); Karlkloof, 4 specimens, no date (no collector).

These specimens agree in most details with Reuter's description of *G. apicalis* from Kilimandjaro. They have a large basal spot on the outside of the anterior femora, unmentioned in Schouteden's description and no doubt comparable to the third ring on the femur of Reuter's species. In three of the individuals (teneral) from Karkloof this basal spot is not noticeable, and in all the specimens the middle ring is incomplete above.

GORPIS CHINAI sp. nov.

Pale flavous, conspicuously marked with reddish brown to dark brown. Head irregularly brown above and beneath, with an interrupted irregular stripe on each side above, a spot on middle of column, and a narrow interrupted stripe on each side below, pale; gula darkest. Narrow base of second antennal segment (ring joint) brown, and a conspicuous ring at its tip black. Pronotum variegated, sides of front lobe and margins behind humeri darkest; front lobe mostly brown, with an oblique pale spot on each side in front of transverse impression (this

pale area at times occupies most of the disc so that only sides and median stripe of front lobe are darker); posterior lobe with a triangular patch on each side of median line, lateral edges and a narrow oblique line on each side of disc darker. Scutellum brown, a spot on each side and median line usually distinctly paler, apex reddish.

Hemelytra with clavus and a characteristic pattern on corium and base of membrane brown, remainder pale, hyaline. Legs pale, front femur with a broad brown ring in front of distal two-fifths; an elongate postmedian spot and a narrow subapical, incomplete ring on hind femur and a basal ring on hind tibia, brown. Mesosternum and mesopleura largely embrowned with irregular pale areas. Metasternum and abdomen immaculate.

Head longer than broad (male, 22:17), vertex wide (8). Eyes small, 7:4:8. Antennal proportions, 40:44:35:24; segment I with few pale hairs, noticeably enlarged along distal third. Rostral formula, 22:20:12. Pronotum distinctly shorter than broad (34:40), anterior lobe narrow, together with collar as long as posterior measured at midline; hind lobe raised above anterior, thickly punctate, its hind margin broadly concave, slightly reflexed on each side. Scutellum, small, not longer than broad. Hemelytra constricted before middle, then strongly widened, pale area of corium minutely punctulate, membrane extending well beyond apex of abdomen. Front coxa barely more than three times as long as broad (28:9), front femur about five times as long as deep (60:12). Male clasper as in text fig. 1, *d*.

Length, 7.6 to 7.9 millimeters; width, 1.86.

Holotype, male, and allotype, female, Malvern, Natal, South Africa, July, 1897, in the collection of the British Museum of Natural History. Paratypes, 1 male and 1 female, taken with type; 1 male, Durban, Natal, 1897; 1 female, Hilton, November, 1897.

GORPIS SIMILLIMUS sp. nov.

Pale yellowish white; eyes, ocelli, and ring toward apex of hind femur reddish, tips of first two antennal segments, apical half of segment III, tip of rostrum, apices of tibiæ and tarsi, spot at apex of claval commissure, streak along lateral margins of front lobe of pronotum, an indistinct spot at distal third of front femur on its posterior (exterior) side, and three small irregular spots exteriorly on front femur proximal to its middle, embrowned to testaceous. Head longer than broad (25:20),

vertex (10) flatter than in *clavatus*. Eyes more oval than in *clavatus*, 9:5:8. Antennæ long, segment I of equal thickness throughout, with a few fine short hairs, 51:70:78; segment IV absent. Rostrum stout, with only a few, very fine, short hairs; formula, 30:25:12.

Pronotum barely longer than broad (38:37), not noticeably pilose, collar long, indistinctly punctate, anterior lobe suddenly raised above collar, arched; median constriction deep, posterior lobe strongly raised above anterior, thickly, rather finely and regularly punctate, punctures rounded; base feebly emarginate. Scutellum moderate, faintly longer than broad, tip pointed. Hemelytra subhyaline, almost parallel-sided, margins with only a few fine hairs. Anterior coxæ elongate, over five times as long as thick (42:8). Front femur as long as head, pronotum and scutellum (except tip) conjoined, nearly seven times as long as deep (89:13). Abdomen elongate, not expanded distally. Male clasper as in text fig. 1, *c*.

Length, 9.5 millimeters; width, 1.75.

Holotype, male, New Hebrides; Malekula, January, 1930 (*L. Evelyn Cheesman*); in the collection of the British Museum of Natural History.

This species seems nearest *G. flavicans* Harris from Luzon.

GORPIS CLAVATUS sp. nov.

Pale yellowish white; ocelli and eyes reddish, base of antennal segment II (ring joint), tip of rostrum, and tip of tarsi fuscous. A streak on each side of base of head, a short line to each side of center of disc of scutellum, margin of clavus along basal half of commissure, a streak along apical part of claval suture and margin of membrane (forming an X when hemelytra are at rest), a small spot on membrane before apex of corium, two spots on each side of anterior femur (the one at basal fourth indistinct, the other beyond the middle), and an indistinct spot before apex of hind femur, testaceous or embrowned; an apical ring on antennal segment II piceous. Head (measured to collum) longer than broad (male, 26:18). Vertex (8) arched. Eyes small, 8:5:3. Antennæ with few hairs, segment I distinctly enlarged along apical two-fifths; 40:45:56:32. Rostral formula, 25:20:13.

Pronotum not longer than broad (39:38), its sides and propleura conspicuously clothed with long pale hairs; collar long, punctate; posterior lobe coarsely rugosely punctate, punctures elongate; base only feebly sinuate. Scutellum small, as

broad as long, tip short, fine, slightly recurved. Hemelytra shiny, hyaline, constricted on basal third, then strongly expanded; costal margin noticeably ciliate; membrane strongly surpassing tip of abdomen. Fore coxæ only about three times as long as thick (27: 9). Fore femur stout, about six times as long as deep (66 : 11), its length equal to head and pronotum conjoined. Abdomen slightly expanded distally. Male clasper as in text fig. 1, *b*.

Length, 9.2 millimeters; width, 1.7; hemelytra, 2.1.

Holotype, male, and allotype, female, South Africa, Malvern, June 17, 1897, in the collection of the British Museum of Natural History. Paratype, 1 male, taken with types.

GORPIS RUFINERVIS Poppius.

Gorpis rufinervis POPPIUS, Ann. Mus. Zool. Acad. Sci. 19 (1914) 138.

Head longer than broad (32 : 21); vertex broad (9). Eye, 11 : 6 : 9. Antennæ stout; segment I thinner on basal fourth, conspicuously clothed with stout, dark hairs, 55 : 70 : 71 : 27. Rostrum with stout, almost erect dark hairs on basal half; formula, 25 : 21 : 13. Pronotum longer than broad (53 : 48), punctures of hind lobe quite coarse and tending to be elongate, shoulders tumid, basal margin faintly sinuate. Scutellum injured but apparently not noticeably longer than broad. Hemelytra only faintly widened posteriorly, membrane extending well beyond apex of abdomen. Fore coxæ stout, only about three times as long as thick (32 : 10). Front femur nearly eight times as long as deep (92 : 12), slightly longer than head and pronotum conjoined. Clasper as in text fig. 1, *h*.

Length, 13.2 millimeters (11.7 to apex of venter); width, 2.2 (2.6 across hemelytra).

SOUTH AFRICA, Pinesoun (?), May, 1917, Marley; Natal, Kloof, 1,500 feet, 1 male, August, 1926, no collector.

These individuals are mutilated and somewhat teneral, and show only faint evidence of the dark hemelytral markings described by Poppius. They agree with the description in all other respects, however, and thus are tentatively referred to *rufinervis*. They are larger and noticeably stouter than a specimen of *G. cribraticollis* from Ceylon in my collection, and have much stouter antennæ and fore coxæ. The eyes are less sharply rounded exteriorly, and the pronotum is longer and broader and is inflated within the humeral angles.

GORPIS SORDIDUS Reuter.

Gorpis sordida REUTER, Ann. Ent. Soc. Belg. 52 (1909) 428.
Gorpis sordidus HARRIS, Philip. Journ. Sci. 43 (1930) 419, fig. 1, *a*.

PAPUA, Mafulu, 4,000 feet, 4 specimens, January, 1934 (*L. Evelyn Cheesman*); Oquali, 4,500 feet, July, 1933; Mondo, 5,000 feet, January, 1934. These specimens are of especial interest because Reuter's types were from New Guinea. The clasper of the male appears to differ slightly from that of a specimen in my collection from Los Baños, Luzon.

GORPIS PAPUANUS sp. nov.

Color and pattern as in the very closely allied *G. sordidus* Reuter, but recognizable by its larger size, larger eyes, longer antennæ and legs, and slightly differently formed male clasper.

Head (measured to collum) longer than broad (male, 27:24), interocular distance (9) slightly greater than length of an eye, anteocular part not as porrect and swollen as in *longispinis*. Eye, length: width: depth, 10:7.5:10.5. Antennæ very long; segment I of equal diameter throughout its length, clothed with a few fine, short hairs; segments, 72:103:130:32. Rostral formula, 35:37:15. Pronotum as long as broad (40:40), front lobe smooth, somewhat arched, sharply raised above collar; hind lobe thickly, moderately finely, punctate, slightly impressed on each side next to humeri, base broadly, shallowly concave. Scutellum obviously longer than broad, apex slightly produced and swollen. Hemelytra opaque, only feebly expanded beyond apex of clavus; membrane, except along base, hyaline; extending well beyond tip of abdomen. Anterior coxa about seven times as long as thick (58:8) and almost as long as pronotum and scutellum conjoined. Anterior femur about eight times as long as thick (105:13), swollen below and slightly concave above, its tibia distinctly bowed, its tarsus very long. Tergum with segments margined with crimson. Male clasper as in text fig. 1, *a*.

Length, male, 10.7 millimeters, female, 11.8; width, 1.8 to 2.1.

Holotype, male, and allotype, female, Kokoda, Papua, 1,200 feet, August, 1933 (*L. Evelyn Cheesman*); in the collection of the British Museum of Natural History. Paratypes, 1 male and 2 females, taken by Miss Cheesman at the type locality in April; 2 males, taken in May; 2 males and 2 females, taken in June; 2 females, taken in September; 1 female, collected at Ishurova, 3,000 feet, July, 1933.

Because of its very apparent kinship with *G. sordidus*, which occurs on the same island but apparently at higher altitudes, this form should be of interest to students of distribution in its relation to speciation.

GORPIS NEGLECTUS sp. nov.

Pale yellowish white, eyes, ocelli, apical ring on hind tibia, and two spots on each side of anterior femora reddish to crimson. Head longer than broad (24 : 20), vertex about as in *simillimus*. Eyes smaller than in *simillimus*, 8 : 5.5 : 8. Antennæ with segment I of about equal thickness throughout its length, with sparse, short, fine hairs; proportions of segments, 46 : 62 : 73 : 35. Rostrum stout, 25 : 20 : 12. Pronotum (37 : 37) about as in *simillimus;* hemelytra slightly broader and with more nearly parallel sides, claval commissure shorter, its length equal to distance across eyes. Anterior coxæ only about four times as long as thick (35 : 9). Front femur about six times as long as deep (75 : 12), with irregular crimson areas at middle and apical fifth. Male clasper as in text fig. 1, *f*.

Holotype, male, Australia, Lordsborough (*H. Hacker*), March 31, 1934; in my collection.

In many respects this form seems nearest *Gorpis simillimus* and *G. philippinensis* Harris. It may be readily recognized from these, however, by the characters pointed out above as well as by the distinctive clasper of the male.

GORPIS BREVILINEATUS (Scott).

Nabis brevilineatus SCOTT, Ann. & Mag. Nat. Hist. (4) 14 (1874) 445.

Gorpis suzukii MATSUMURA, Thousand Insects Japan Addit. 1 (1913) 179.

Gorpis suzukii FUKUI, Kontyu (2) 2 (1927) 85, pl. 5, fig. 29.

Nabis brevilineatus FUKUI, Kontyu (2) 2 (1927) 87.

Gorpis brevilineatus ESAKI, Kontyu 3 (1929) 224.

Professor Esaki has pointed out that the insect called *Gorpis suzukii* by Matsumura is identical with Scott's *Nabis brevilineatus* from Japan. The Matsumura citation did not appear in the various abstracted journals until a late date, and the species was thus unfortunately omitted from my catalogue of *Gorpis*.[2]

[2] Loc. cit.

ILLUSTRATION

TEXT FIGURE

Fig. 1. Left clasper of males of various species of *Gorpis*. *a*, *Gorpis papuanus* sp. nov.; *b*, *G. clavatus* sp. nov.; *c*, *G. simillimus* sp. nov.; *d*, *G. chinai* sp. nov.; *e*, *G. longispinus* sp. nov.; *f*, *G. neglectus* sp. nov.; *g*, *G. transvaalensis* Schouteden; *h*, *G. rufinervis* Poppius.

HELOTIDÆ OF JAPAN, KOREA, AND FORMOSA (COLEOPTERA)

By Hiromichi Kôno

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The family Helotidæ is represented by only one genus, *Helota* MacLeay.

Genus HELOTA MacLeay

Helota Macleay, Annul. Jav. (1825) 42.
Neohelota Ohta, Ins. Mats. 4 (1929) 68. (*n. syn.*)

After examining the types of *Neohelota tsumaaka* Ohta, *Neohelota miwai* Ohta, and *Helota sonani* Ohta, all of which are preserved in the Entomological Institute of Hokkaido Imperial University, I am convinced that *Neohelota tsumaaka*, the genotype of genus *Neohelota* Ohta, is the male of *Helota helleri* Ritsema, and *Neohelota miwai* is the male of *Helota sonani* Ohta. Furthermore, the type of *Helota sonani*, which Ohta designated as the male, is in reality the female of the species. Consequently I am of the opinion that *Neohelota* Ohta should be regarded as a synonym of *Helota* MacLeay, because the characters given for the former are merely sexual ones of less than generic value.

1. HELOTA THORACICA Ritsema.

Helota thoracica Ritsema, Notes Leyd. Mus. 18 (1896) 49; 34 (1912) 51; Miwa, Syst. Cat. Formosan Col. (1931) 60.
Helota feæ Ritsema ab. *mushana* Ohta, Inst. Mats. 3 (1929) 108, 109; Miwa, Syst. Cat. Formosan Col. (1931) 59. (syn. nov.)
Helota sp. Kato, Bunrui Genshoku Nippon Konchu Zukan 9 (1833) pl. 6, fig. 6.

Distribution.—Formosa; Tibet.

2. HELOTA OBERTHÜRI Ritsema.

Helota Oberthüri Ritsema, Notes Leyd. Mus. 11 (1889) 110; Kato, Bunrui Genshoku Nippon Konchu Zukan 9 (1933) pl. 6, fig. 5.
Helota oberthüri Miwa, Syst. Cat. Formosan Col. (1931) 60.

Distribution.—Formosa (after Miwa); India.

3. HELOTA GEMMATA Gorham.

Helota gemmata Gorham, Trans. Ent. Soc. Lond. (1874) 448 (*pars*); Reitter, Verh. Naturf. Ver. Brünn 16 (1876) 65, pl. 1, figs. 1–5;

HAROLD, Abhandl. Naturf. Ver. Bremen 5 (1876) 119; LEWIS, Col. Cat. Jap. Archip. (1879) 11; WATERHOUSE, Aid Ident. Ins. (1882) pl. 133, fig. 2; OLIFF, Cist. Ent. 3 (1883) 52, pl. 3, fig. 8; SCHÖNFELDT, Cat. Col. Jap. (1887) 94; RITSEMA, Notes Leyd. Mus. 11 (1889) 104; Ann. Mus. Civ. Genova 30 (1891) 888; LEWIS, Entomologist 26 (1893) 150; RITSEMA, Entomologist 26 (1893) 183; Junk Col. Cat. 34 Helotidae (1911) 105; MATSUMURA, Thous. Ins. Jap. 3 (1905) 51, pl. 43, fig. 3; Konchu Bunruigaku 2 (1905) 184; JACOBSON, Käfer Russ.-West-Eur. (1905–1913) 900; WINKLER, Cat. Col. reg. pal. 6 (1926) 714; OHTA, Ins. Mats. 3 (1929) 110; YOKOYAMA, Nippon no Kochu (1930) 116, pl. 15, fig. 2; MATSUMURA, 6000 Ill. Ins. Jap. (1931) 141, fig. 202; Ill. Comm. Ins. Jap. 3 (1931) 32, pl. 8, fig. 11; YUASA, Nippon Konchu Zukan (1932) 711, fig. 1395; KAMIYA and ADACHI, Genshoku Kochu Zufu (1933) pl. 16, fig. 3; KATO, Genshoku Nippon Konchu Zukan 9 (1933) pl. 6, fig. 8.

Distribution.—Japan, Hokkaido, Honshu, Shikoku, Kiushu.

4. HELOTA FULVIVENTRIS Kolbe.

Helota fulviventris KOLBE, Arch. f. Naturg. 52 (1886) 182, pl. 11, fig. 25; RITSEMA, Notes Leyd. Mus. 11 (1889) 104; LEWIS, Entomologist 16 (1893) 183; JACOBSON, Käf. Russ. West-Eur. (1905–1913) 900, pl. 24, fig. 24; RITSEMA, Junk Col. Cat. 34 Helotidae (1911) 105; WINKLER, Cat. Col. reg. pal. 6 (1926) 714; OHTA, Ins. Mats. 3 (1929) 108, 109; MATSUMURA, 6000 Ill. Ins. Jap. (1931) 141, fig. 201; Ill. Comm. Ins. Jap. 3 (1931) 33, pl. 8, fig. 15.

Helota japonica OHTA, Ins. Mats. 3 (1929) 108, 109; MATSUMURA, 6000 Ill. Ins. Jap. (1931) 141, fig. 203. (*n. syn.*)

Helota fulviventris ab. *awana* OHTA, Ins. Mats. 3 (1929) 108, 109.

Distribution.—Japan, Honshu, Shikoku, Kiushu; Korea; Amur.

5. HELOTA GORHAMI Oliff.

Helota Gorhami OLIFF, Cist. Ent. 3 (1883) 53, 56; KOLBE, Arch. f. Naturg. 52 (1886) 181; RITSEMA, Notes Leyd. Mus. 11 (1889) 192; Junk Col. Cat. 34 Helotidae (1911) 105; JACOBSON, Käf. Russ. West-Eur. (1905–1913) 900; WINKLER, Cat. Col. reg. pal. 6 (1926) 714.

Helota gorhami OHTA, Ins. Mats. 3 (1929) 108, 109.

Distribution.—Korea; China.

6. HELOTA SINENSIS Oliff.

Helota sinensis OLIFF, Cist. Ent. 3 (1883) 54, pl. 3, fig. 3; MIWA, Syst. Cat. Formosan Col. (1931) 60.

Distribution.—Formosa (after Miwa); China.

7. HELOTA YEZOANA sp. nov.

Helota cereopunctata OHTA, Ins. Mats. 3 (1929) 108 (*pars*); MATSUMURA, 6000 Ill. Ins. Jap. (1931) 141, fig. 200.

Upper surface of body dark bronze, somewhat coppery shiny; four elytral spots yellow. Antennæ testaceous, slightly infuscated toward base. Under surface mostly reddish testaceous, head (except throat) and elytral epipleuræ metallic green, lateral portions of meso- and metasterna pitchy brown. Femora at apical third and tibiæ metallic green; tarsi and claws pitchy brown.

Head strongly and rather densely punctured. Prothorax trapezoidal, widest at base; lateral edges distinctly crenulate; base bisinuate, hind angles acute; anterior angles somewhat produced and rounded; upper surface at sides strongly and densely punctured, with some scattered punctures near middle, except impunctate longitudinal central portion. Scutellum small, transverse, impunctate. Elytra nearly parallel, rounded posteriorly, each with ten regular, punctured striæ; interstices impunctate, 1st, 2d, 6th, and 8th interstices costate on apical portion; anterior yellow spot occupying interstices of 4th, 5th, and 6th striæ; posterior yellow spot placed between 3d and 6th striæ. Underside of head (with exception of impunctate throat) and lateral portions of thorax distinctly punctured. Legs on metallic portions distinctly punctured. Anterior tibiæ strongly curved, shallowly furrowed along under side. Abdomen smooth, finely punctured; last ventral segment subtruncate at apex and provided with a tomentose impression.

Length, 7.5 millimeters.

Holotype, female, Jozankei, Hokkaido, June 2, 1935, *H. Kôno.*

Paratype, male, Jozankei, Hokkaido, September, 1908, *S. Matsumura.*

This species resembles *Helota cereopunctata* Lewis, from which it differs in the slenderer body and in the reddish testaceous lateral portions of the prothorax.

8. HELOTA CEREOPUNCTATA Lewis.

Helota cereo-punctata Lewis, Ent. Month. Mag. 17 (1881) 225; Ritsema, Junk Col. Cat. 34 Helotidae (1911) 104.

Helota cereopunctata Ritsema, Entomologist 26 (1893) 183; Jacobson, Käf. Russ. West-Eur. (1905–1913) 900; Winkler, Cat. Col. reg. pal. 6 (1926) 714.

Distribution.—Honshu (after Lewis).

9. HELOTA TAIWANA Ohta.

Helota taiwana Ohta, Ins. Mats. 4 (1929) 66; Miwa, Syst. Cat. Formosan Col. (1931) 60.

Neohelota pusilla KATO (*nec* Oberthür, Bunrui Genshoku Nippon Konchu Zukai 9 (1933) pl. 6, fig. 1, 2. (syn. nov.)

Distribution.—Formosa.

10. HELOTA HELLERI Ritsema.

Helota helleri RITSEMA, Notes Leyd. Mus. 34 (1912) 51.

Helota helleri OHTA, Ins. Mats. 3 (1929) 108, 109; MIWA, Syst. Cat. Formosan Col. (1931) 59.

Neohelota tsumaaka OHTA, Ins. Mats. 4 (1929) 66, 68; MATSUMURA, 6000 Ill. Ins. Jap. (1931) 141, fig. 204; MIWA, Syst. Cat. Formosan Col. (1931) 60. (syn. nov.)

Distribution.—Formosa.

11. HELOTA SONANI Ohta.

Helota sonani OHTA, Ins. Mats. 4 (1929) 66, 67, female (no male); MIWA, Syst. Cat. Formosan Col. (1931) 60.

Neohelota miwai OHTA, Ins. Mats. 5 (1931) 136; MIWA, Syst. Cat. Formosan Col. (1931) 60. (syn. nov.)

Helota fœ ab. *mushana* KATO (*nec* Ohta), Bunruin Genshoku Nippon Konchu Zukan 9 (1933) pl. 6, fig. 6; MIWA, Syst. Cat. Formosan Col. (1931) 59.

Distribution.—Formosa.

12. HELOTA MONTANA Ohta.

Helota montana OHTA, Ins. Mats. 4 (1929) 66, 67; MIWA, Syst. Cat. Formosan Col. (1931) 60.

Distribution.—Formosa.

13. HELOTA SEMIFULVA Ritsema.

Helota semifulva RITSEMA, Notes Leyd. Mus. 3 (1881) 80; MIWA, Syst. Cat. Formosan Col. (1931) 60.

Distribution.—Formosa (after Miwa); Java.

TWO RARE PEDICULATE FISHES FROM THE PHILIPPINES

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ONE PLATE

This paper is a systematic account of two rare Philippine fishes based on three specimens trawled from a depth of 30 fathoms in the China Sea in the vicinity of San Narciso, Zambales Province. These specimens form a part of the ichthyological collection of the Fish and Game Administration, Bureau of Science, Manila.

LOPHIIDÆ

ANGLERS

Body contracted, conical, tapering sharply backwards from shoulders. Skin mostly smooth, naked, with many dermal flaps about head. Head wide, depressed, exceedingly large. Mouth very large, terminal, opening into an enormous stomach; upper jaw protractile; maxillary without supplemental bone; lower jaw projecting, both jaws with very strong, unequal, depressible cardiform teeth, some caninelike. Vomer and palatines usually with strong teeth. Spinous dorsal of 3 isolated, tentaclelike spines on head, and 3 smaller spines behind, forming a continuous fin; second dorsal moderate, similar to anal. Pectoral membranes scarcely geniculated, each with 2 actinosts and elongate pseudobrachia. Ventrals jugular I, 5 widely separated. Branchial apertures comparatively large, in inferior axils of pectorals. Gills 3, without gill rakers. Pseudobranchiæ present.

Carnivorous fishes living at moderate or great depths of temperate and tropical seas in the Pacific, Atlantic, and Indian Oceans.

Genus LOPHIOMUS Gill

Lophiomus GILL, Proc. U. S. Nat. Mus. 5 (1882) 552.

Head large, depressed, subcircular, occupying most of body, with several spines. Teeth in lower jaw mostly in 3 series, anteriorly in 4 series. Opercular membrane without free pos-

terior margin. Gill openings wide below pectorals, extending beyond them posteriorly. Pectorals broad, with 22 or 23 rays, bases retractible into branchial apertures. Spinous dorsal with six spines. Soft dorsal with 8 rays; anal with about 6 rays, last ray cleft to base and supported by a single basal bone. Vertebræ about 19.

LOPHIOMUS SETIGERUS (Vahl).

Lophius setigerus VAHL, Skrivt. Naturh. Selsk. IV 1 (1797) 215.
Lophius viviparus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 142.
Lophius indicus ALCOCK, Journ. Asiatic Soc. Bengal 58 (1889) 302; Descriptive catalogue of Indian Deep-Sea Fishes in Indian Mus. (1899) 53.
Lophiomus setigerus JORDAN and EVERMANN, Bull. U. S. Nat. Mus. 47 pt. 3 (1898) 2714; REGAN, Ann. & Mag. Nat. Hist. 11 (1903) 282; WHITLEY, Rec. Aust. Mus. 16 (1927–1929) 236.

Head, 2; dorsal, I, I, I, III—8; pectoral, 22; ventral, I, 5; anal, 7; caudal, 7.

Head as broad as long. Mouth terminal, wide, oblique, lower lip extending beyond upper, exposing lower teeth. Teeth small, unequal, depressible on jaws; two series in upper, an outer row of smaller teeth and an inner twice as long; lower jaw with irregular series mostly in 3 rows, 4 rows anteriorly. One or two strong teeth on each side of vomer; four or five in palatine. Anterior part of tongue whitish, with a network of black lines. Eye small, slightly less than interorbital space. Snout 2.3 in head, with characteristic concavity in front of eye, bordered by two strong spines anteriorly. Operculum with four spines, three at preopercle, one at superior angle of opercle. First spine of preopercle at edge of disc pointing forward, other two outward. Other spines of head, two short ones behind angle of mouth, two in supraorbital, four in postorbital, three on medial ridge bordering concavity before eye, two at occiput, one at ridge between head and humeral process. Humeral spine trifid, first point vertical, other two directed posteriorly. Gills three; gill openings transverse, wider than eye, below pectorals, at hind edge of disc.

Spinous dorsal modified, composed of somewhat isolated spines. Foremost dorsal spine, a bristle with fleshy bait, reaching base of third dorsal spine. Second dorsal spine shorter than first, fringed throughout. First and third longest. Base of soft dorsal 2.5 in head. Pectorals broad with rounded mar-

gin, length about equal to distance from mouth to hind margin of eye. Ventrals small, 1.7 in caudal. Origin of anal below fourth ray of soft dorsal. Caudal subtruncate, 5.4 in total length.

Alcoholic specimens brownish olive, dermal flaps darker; ventral surface whitish.

Described from No. 31936, 63 mm, and No. 31937, 55 mm, trawled by M/L "Science I" from a depth of 30 fathoms in the China Sea off San Narciso, Zambales Province, Luzon, Philippine Islands, February 10, 1937. These are the first Philippine specimens taken of this genus and species.

Known to inhabit certain depths of the sea from the coast of Malabar to the seas of China and Japan.

OGCOCEPHALIDÆ

BAT FISHES

Head very broad and depressed, snout more or less elevated; trunk short and slender, mouth small, subterminal or inferior, lower jaw included, teeth villiform or cardiform. Gill openings very small, above and behind axils of pectorals. Body and head covered with bony tubercles or spines. Spinous dorsal reduced to a small rostral tentacle which is retractile into a cavity under a prominent process on forehead. Soft dorsal and anal small and short, ventrals well developed. Pectoral base strongly angled with long pseudobrachia and 3 actinosts. Branchiostegals 5. No pseudobranchiæ.

Fishes inhabiting warm waters of the Atlantic, Pacific, and Indian Oceans.

Genus HALIEUTOPSIS Garman

Halieutopsis GARMAN, Mem. Mus. Comparative Zoöl. Harvard 24 (1899) 89.

Head wide, broadly rounded forward; rostrum and skull raised above balance of disclike head. Snout indented; subopercular region much swollen. Eyes small. Rostral niche deep; rostrum overhanging; illicium protractile and depressible, esca with two large spherical bulbs and a median slender bifurcated more mobile portion. Mouth medium, anterior, overhung by swollen margins. Teeth absent from vomer, palatines, and apparently from tongue. Subopercular process and spines well developed. Gills two, none on first and fourth arches.

HALIEUTOPSIS VERMICULARIS Smith and Radcliffe.

Halieutopsis vermicularis SMITH and RADCLIFFE, Proc. U. S. Nat. Mus. 42 (1912) 209; KAMOHARA, Annot. Zool. Japon. (1) 16 (1937) 12.

Head, 1.7; depth, 3; dorsal, 4; pectoral, 11; ventral, 5; anal, 3; caudal, 6.

Body short, slender, tapering posteriorly. Head comparatively broad, depressed, subcircular. Mouth small, subterminal. Jaws subequal, upper slightly protruding forward. Narrow band of villiform teeth in jaws and tongue, absent from vomer and palatines. Snout equal to eye, bluntly rounded anteriorly. Nostrils moderate, lying in a depression in anterior margin of rostrum. Illicial niche less than eye diameter, overhung by arched rostrum which projects beyond jaws. Illicium trilobed, two basal wedge-shaped bulbs and an upper median spherical lobe. Eye small, 5 in head. Interorbital equal to eye, trough-like, deep. Gill openings small, well ahead of pectoral base, forward and toward side of tail. Gills 2, gill rakers short, fleshy tubercles, six on lower arch of first.

Dorsal surface covered with stellate tubercles capped with spines. Minute tubercles between large ones. Rostral spines strong, an erect median spine overhanging tentacular cavity, with one lateral oblique bicuspid spine on each side. Large tubercles on sides of disc with bifid and trifid spinules. Ventral surface of disc naked, except for small spinous tubercles below mandible and minute fleshy tubercles scattered all around ventrally.

Soft dorsal origin about midway between occiput and tip of caudal, longest rays 5 in standard length. Pectorals 1.9 in head. Ventrals as long as soft dorsal, set wide apart. Anal inserted below soft dorsal base, its length 2 in pectoral. Caudal truncate, 2 in width of head.

Alcoholic specimens grayish olive; dorsal surface with olive vermiculations; tips of soft dorsal, anal and caudal dusky, ventral surface colorless.

Here described from specimen No. 31935, 34 mm long, trawled by M/L "Science I" at a depth of 30 fathoms off San Narciso, Zambales Province, Luzon, Philippines, February 10, 1937.

ILLUSTRATION

PLATE 1

FIG. 1. *Lophiomus setigerus* (Vahl); dorsal view.
2. *Halieutopsis vermicularis* Smith and Radcliffe; dorsal view.
3. *Lophiomus setigerus* (Vahl); ventral view.
4. *Halieutopsis vermicularis* Smith and Radcliffe; ventral view.

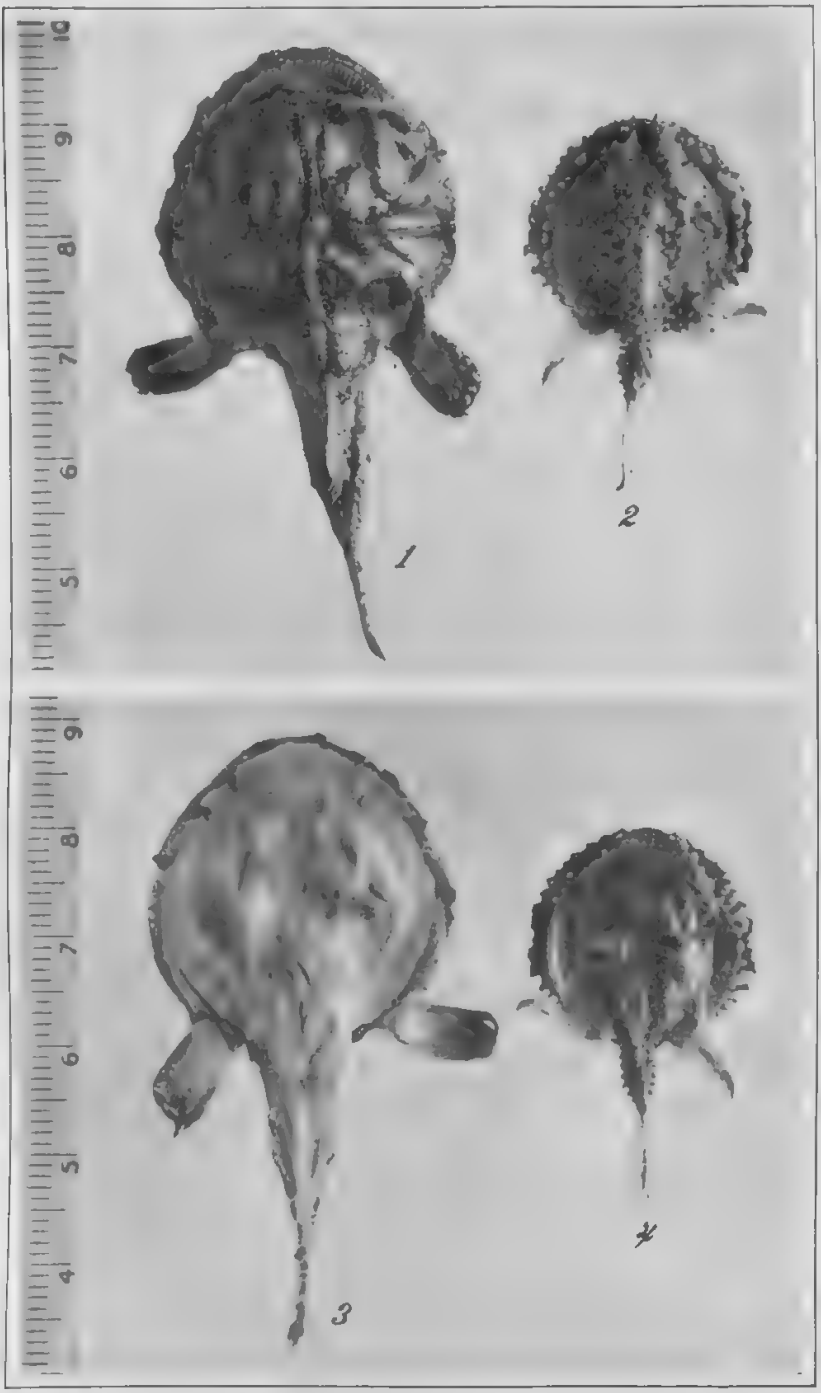

PLATE 1.

TWO NEW DECAPODS FROM THE PHILIPPINES

By GUILLERMO J. BLANCO

Of the Fish and Game Administration, Bureau of Science, Manila

TWO PLATES

In this paper are given the descriptions of two new Philippine species of *Palæmon*. The specimens of *P. lagdaoensis* were collected from the brackish portions of Cagayan River at Aparri, March, 1938. Those of *P. talaveræ* were collected by Mr. Florencio Talavera from Sampaloc Lake, San Pablo, Laguna Province, February 25, 1931.

The classification of the smaller varieties of Philippine palæmons is still lacking. In 1914 R. P. Cowles described ten species of fresh-water palæmons. The specimens described were mostly of larger varieties of prawns. Recently a new species of marine *Palæmon* from northern Luzon was described. This brings up to a total of thirteen the number of *Palæmon* species known to inhabit the seas and inland waters of the Philippines.

Genus PALÆMON Fabricius

Rostrum well developed, laterally compressed, toothed above and below. Carapace smooth, furnished with antennal and branchiostegal or hepatic spines. Pterygostomian spine wanting. Mandible with 3-jointed palp.

PALÆMON LAGDAOENSIS sp. nov. Plate 1.

Rostrum short, slightly curved upwards a little beyond antennal scale; rostral $\frac{6}{5-6}$-dentate, 6 prominent teeth on upper margin, only 1 tooth on carapace, behind orbital margin; 5 to 6 teeth on lower margin; tip bifid. Carapace smooth; antennal and branchiostegal spines present; supraorbital and hepatic spines absent; pterygostomian angle rounded. Eyes slender, twice as long as wide, cornea 2.5 times its dorsal length; ocellus brownish to blackish. Mandible with molar and incisor process with 3-jointed palp (Plate 1, fig. 2). Maxillule cross-shaped, distal margin of lacinia with spinelike structures and setæ, endopodite thumblike (Plate 1, fig. 3). Third maxilliped with hair structures, reaching beyond ischium of first peræopod.

Lateral process of basal segment of first antennular peduncle ending in acute spine, reaching beyond middle of next segment. Outer antennular flagellum as long as inner flagellum. Antennal scale parallel-sided, 2.5 times as long as broad; outer margin straight, terminating with acute spine.

First peræopods equal in size and length, reaching beyond antennæ scale by their chela or reaching tip of rostrum. Chela with tufts of hairs; 3 times in carpus; mobile and immobile fingers with minute spines at cutting edge. Fingers as long as palm. Second peræopods equal in size and length, long, reaching beyond rostrum by tip of merus and chela. Chela, with tufts of hairs, 1.25 times in carpus, cutting edge of mobile finger with three teeth, of immobile finger with one tooth (Plate 1, fig. 4), fingers as long as palm.

Third, fourth, and fifth legs similar, fifth longer than third or fourth. Dactylus of third and fourth slightly curved; dactylus of fifth leg much curved. Propodus twice as long as carpus; posterior borders armed with slender spines in pairs.

Body robust in female, dorsally rounded. Abdominal pleura rounded in first to third somites; fourth and fifth acutely pointed behind. Sixth abdominal somite longer than fifth; breadth twice in dorsal length. Pleopods moderate, usually foliaceous. Telson tapering, with two pairs of curved spines dorsally. Apex of telson with rounded corners pointed at tip with two short equal externolateral spines and two long internolateral spines; between them a pair of setæ. Uropods each with a distinct spine.

Type locality.—Cagayan River. Specimens caught in scissor nets.

Color.—Live specimens yellowish brown with pink eggs in female. Specimens in alcohol yellowish pink.

Measurements.—Several specimens collected from Cagayan River within vicinity of Bisugu, Aparri, Cagayan, March, 1938, ranging from 32 to 40 mm, from tip of rostrum to tip of telson.

This new species is named *lagdaoensis* after the word *lagdao*, the local name for small fresh-water or brackish-water forms of prawns.

PALÆMON TALAVERÆ sp. nov. Plate 2.

Rostrum short, slightly curved, a little beyond antennal scale, $\frac{8\text{–}11}{3\text{–}4}$ -dentate, 8 to 11 prominent teeth on upper edge, two teeth on carapace, one behind orbital margin, the other just above

eye orbit; tip not bifid. Carapace smooth; antennal and hepatic spines present; branchiostegal spine wanting; pterygostomian angle rounded. Eyes slender, two times as long as wide, cornea 2.5 times its dorsal length.

Mandible with molar and incisor process with 3-jointed palp (Plate 2, fig. 2). Third maxilliped reaching beyond ischium of first peræopod. Lateral process of basal segment of first antennular peduncle ending in acute spine, reaching beyond middle of next segment. Outer antennular flagellum as long as inner flagellum. Antennal scale 3.5 times as long as broad, outer margin nearly straight, terminating in acute spine.

First peræopods equal in size and length, reaching beyond antennal scale and reaching beyond tip of rostrum. Chela with tufts of hairs (Plate 2, fig. 3); mobile and immobile fingers with minute spines at posterior cutting edge. Fingers a little longer than palm. Second paræopods equal in size and length, long, reaching beyond rostrum by one half of merus and chela. Chela without tufts of hairs; 1.2 times in carpus; cutting edge of mobile finger with two teeth; of immobile finger with three teeth (Plate 2, fig. 4); fingers as long as palm. Third, fourth, and fifth peræopods similar, fifth slightly longer than preceding two. Dactylus of fifth peræopod curved, third and fourth slightly curved. Propodus twice as long as carpus; posterior borders armed with slender spines in pairs.

Body not robust, dorsally rounded. Abdominal pleura rounded in first, second, and third somites, fourth and fifth acutely pointed behind. Pleopods moderate in size, usually foliaceous. Sixth abdominal somite as long as fifth dorsally. Telson tapering with two pairs of dorsal spines and one spine at apex. Apex of telson not rounded, corners pointed at tip, with two short equal externolateral spines, and two long internolateral spines, and in between three unequal long setæ. Uropods each with a distinct spine.

Type locality.—Sampaloc Lake, San Pablo, Laguna Province, Luzon.

Color.—Specimens in alcohol yellowish.

Measurements.—Several specimens collected from Sampaloc Lake, San Pablo, Laguna Province, range from 17 to 35 mm in length, from tip of rostrum to tip of telson.

The specific name is given in honor of Mr. Florencio Talavera, who is responsible for the identification of most of the carcinological collections of the Bureau of Science.

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ILLUSTRATIONS

[Drawings by Guillermo J. Blanco.]

PLATE 1. PALÆMON LAGDAOENSIS SP. NOV.

FIG. 1. Female, lateral view; × 3.5.
2. Mandible with palp; × 30.
3. Maxillule; × 30.
4. Portion of chela of second walking leg; showing cutting edge; × 30.
5. Dorsal portion of telson, showing dorsal spines; × 30.
6. Terminal portion of telson; × 50.

PLATE 2. PALÆMON TALAVERAE SP. NOV.

FIG. 1. Male, lateral view; × 3.5.
2. Mandible with palp; × 30.
3. Chela of first walking leg; × 30.
4. Portion of chela of second walking leg, showing cutting edge; × 30.
5. Dorsal portion of telson, showing dorsal spines; × 30.
6. Terminal portion of telson; × 60.

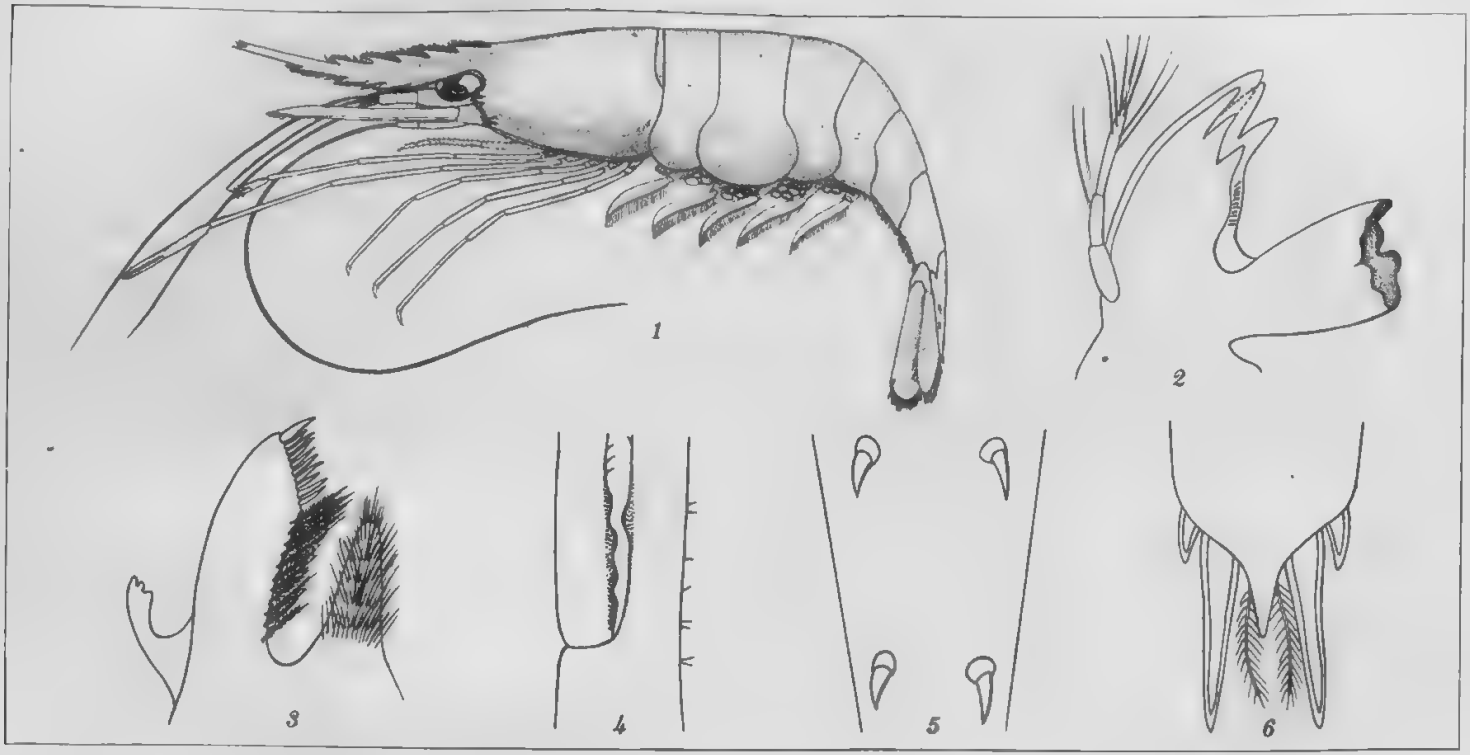

PLATE 1. PALÆMON LAGDAOENSIS SP. NOV.

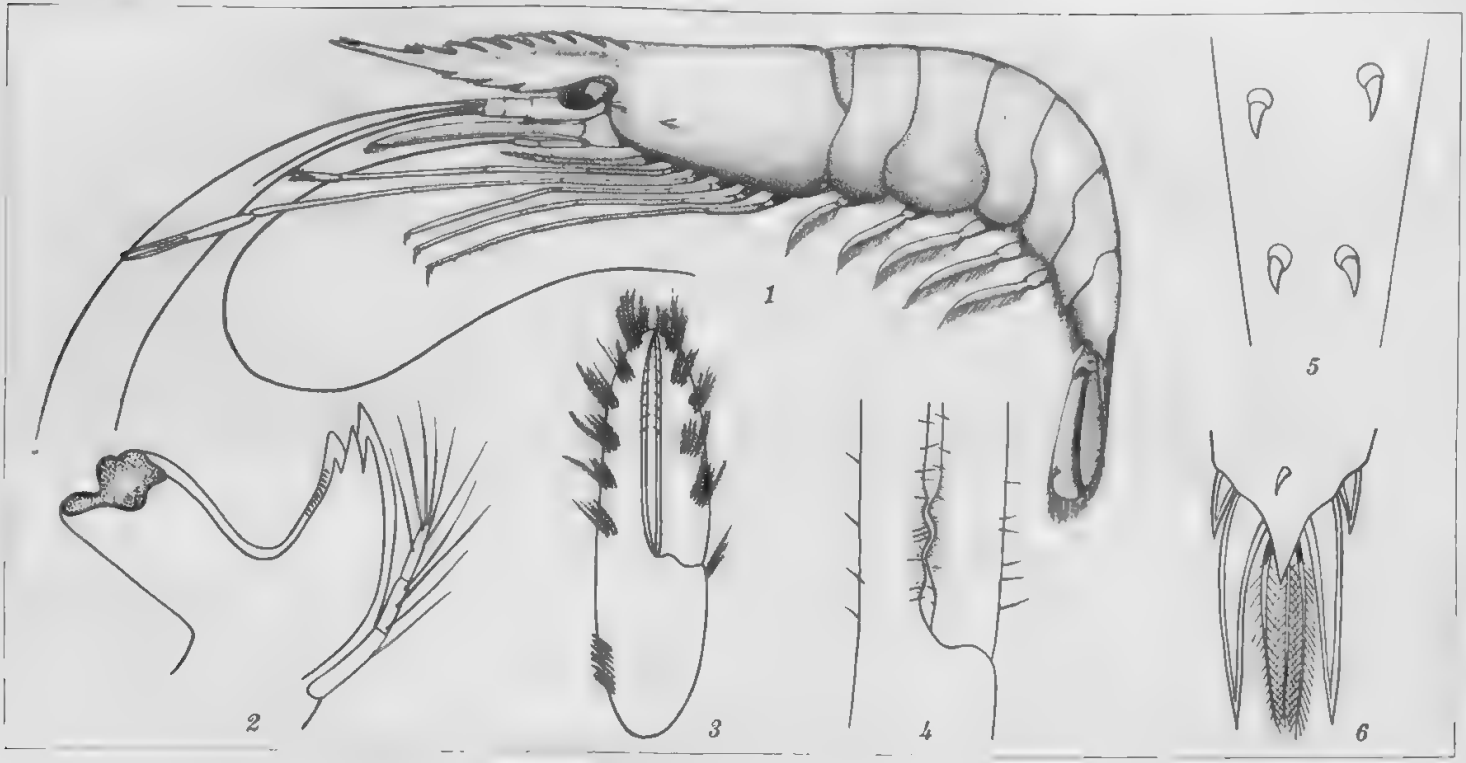

PLATE 2. PALÆMON TALAVERÆ SP. NOV.

SNAIL FISHING AND DUCK RAISING IN LAGUNA DE BAY, LUZON

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FOUR TEXT FIGURES

Since 1918 there has been a noticeable increase in the capital invested in the duck industry in Laguna de Bay. At present there are no less than 300,000 duck layers kept in the various towns bordering the lake. It is claimed that this progress in the duck industry has been attained as a result of the introduction and use of the *kaladkad* (text fig. 1, *a*) system of gathering snails. Previous to 1918 the *pañgahig* (text fig. 1, *b*) was employed by the duck raisers for snail fishing. The rapid increase in the number of birds kept and fed mostly with snails eliminated the use of this device, for it was inefficient and difficult to operate.

The kaladkad system which is now extensively used in snail fishing is being carefully studied to determine its relation to the fauna of the lake in general, with the extent of the snail fishery, and the effects of this industry on the other fishing gear employed in the lake.

SNAILS AS FEED FOR DUCKS

Mollusks represent the bulk of food of domesticated ducks kept around Laguna de Bay. People engaged in this industry maintain that the only way to raise these birds profitably is to feed them wholly or partially with snails. Alonte (1930) reported that approximately 2 or 3 *kaengs* of *Vivipara angularis* (*susong pangpang*) are consumed by 100 ducks a day. One kaeng contains approximately from 50,000 to 60,000 mature snails, or an average of 55,000. The 300,000 duck layers consume, therefore, an average of 7,500 kaengs or 412,500,000 snails a day, a comparatively large quantity taken from the small snail-bed area available in the lake.

Because of the scarcity of *V. angularis*, several other species of shells are gathered in large quantities. Among these are

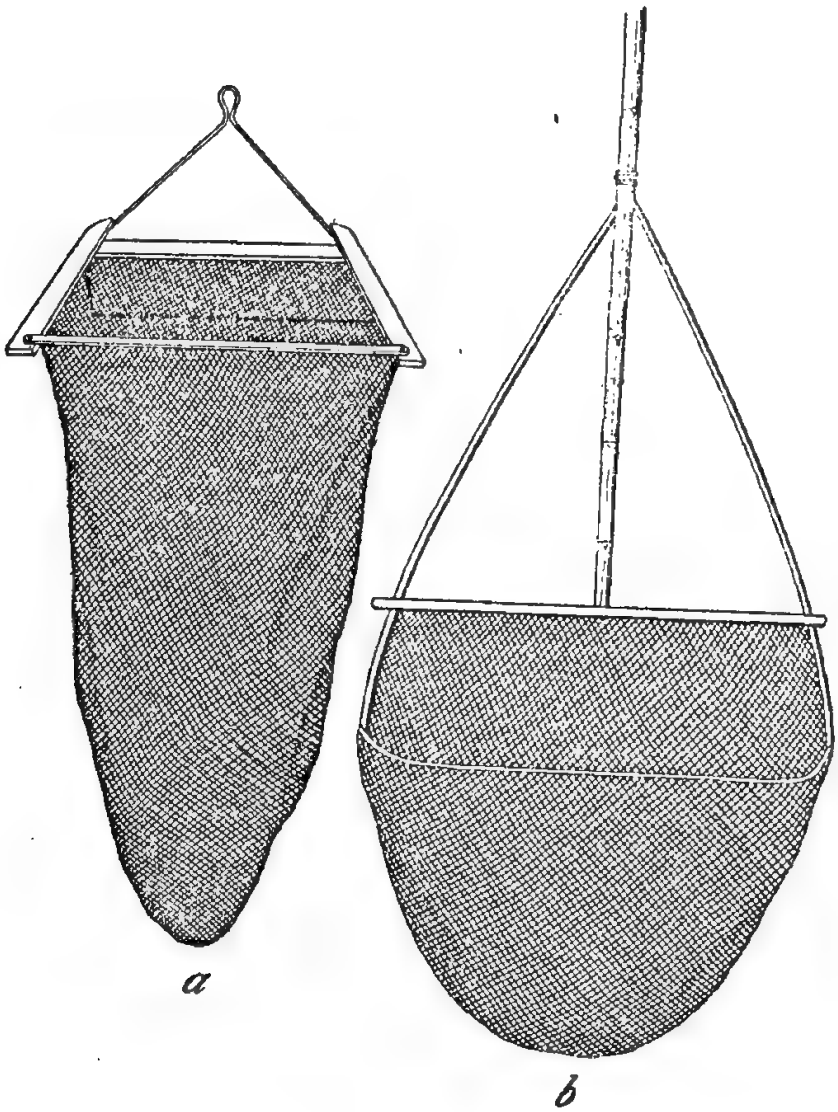

FIG. 1. Snail-fishing gear used in Laguna de Bay. *a*, Kaladkad; *b*, pañgahig.

Ampullaria luzonica Reeve (Ampulariidæ); *Melania lateritia* Lea, *M. scabra* Müller, *M. pantherina* van den Bosch, and *M. asperata* Lamarck (Melaniidæ); and *Corbicula manillensis* Philippi (Cyrenidæ).

SNAIL POPULATION OF LAGUNA LAKE

The snail population in the lake has a wide distribution. From the edge to the middle of the lake *V. angularis*, together

with other species of shells, are known to thrive. The best breeding ground for *V. angularis* and the several species of *Melania*, however, is the muddy bottom of the lake from where the bulk of snails are hauled. *Corbicula manillensis* is known to inhabit sandy and stony bottoms. Thus the amount of this shell caught by the kaladkad is insignificant, as this gear cannot be operated in such places.

The area of Laguna de Bay is 930.7 square kilometers, and the area open for the kaladkad fishermen is placed at about

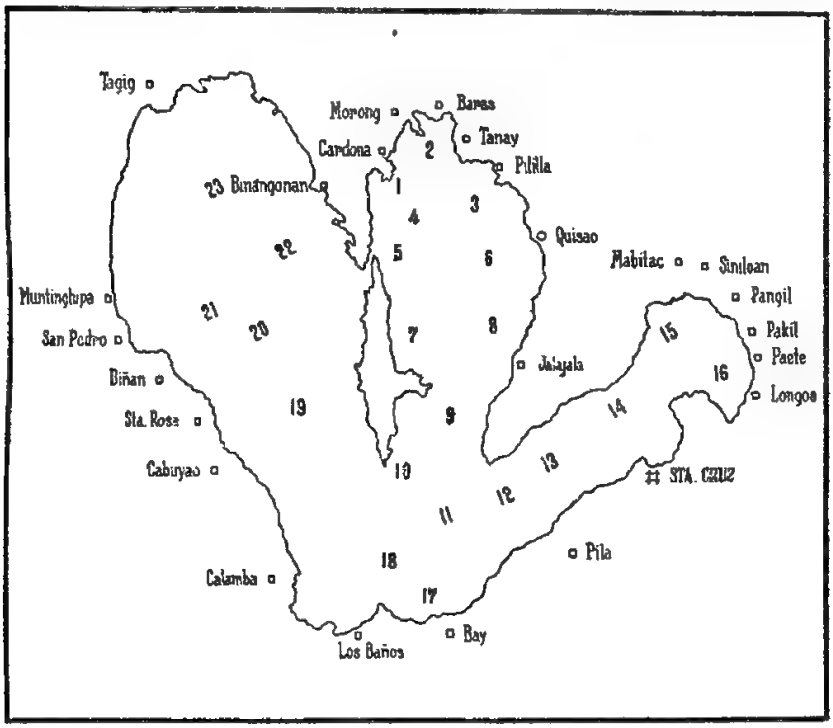

FIG. 2. Map showing the number of *V. angularis* per square meter, taken at random in Laguna de Bay.

850 square kilometers. The remaining 80.7 square kilometers are either occupied by fish corrals and various kinds of bamboo fish traps, or have sandy and gravelly bottom. Snail fishing in the latter region is very inconvenient, due to the obstructions met with in the operation of the kaladkad. Furthermore, the operation of any fishing gear within a radius of 100 meters from the fish corrals is prohibited. In spite of the wide area open for the kaladkad fishermen, however, many of them are hauling snails within prohibited zones,

Snail fishermen when interviewed about the relative abundance of snails in the lake confirmed the finding that the snails are becoming scarcer from year to year. The snail supply in the open portions of the lake is so low that even if snail fishing is allowed within prohibited zones the snails procurable are not sufficient to meet present or future demand.

QUANTITY OF VIVIPARA ANGULARIS AVAILABLE

In order to ascertain the approximate *Vivipara angularis* population in Laguna de Bay, 23 plots of 1 square meter each were selected at random, and the snails available on them were taken and counted June 30, 1937. Table 1 and text fig. 2, showing a map of the lake, show the places where the snails were taken. The average number of *V. angularis*, *Melania* spp., and *C. manillensis* per square meter was found to be 18, 318, and 14, respectively. *Melania* spp. and *C. manillensis* were also counted, because they are now being used as substitute for *V. angularis*. They are not, however, as valuable a feed as *V. angularis*, which is considered best for egg production.

TABLE 1.—*Number of Vivipara angularis taken per square meter at random in Laguna de Bay.*

Locality.	Lot No.	*Vivipara.*	*Melania.*	*Corbicula.*	Total.	Depth.
						Ft.
Looc Cove, Cardona	1	2	522	6	530	8
Between Baras and Tanay	2	13	518	57	588	12
Between Pililla and Quisao	3	22	405	8	455	10
Sorosoro	4	5	617	13	636	17
Near mouth of Diablo Pass	5	24	311	0	335	23
Bagumbayan	6	46	427	0	473	12
Between Lambac and Boor	7	10	308	0	318	15
Between Boor and Jalajala Point	8	1	629	8	638	14
Between Balibago and Jalajala Point	9	18	633	5	656	15
Talim Point	10	0	504	12	516	17
Between Jalajala Point and Bay Island	11	23	347	61	431	14
Between Jalajala Point and Pila	12	68	54	0	122	10
Between Jalajala Point and Nanghaya	13	36	221	21	278	8
Between Bagombong and Santa Cruz	14	4	872	7	883	8
Lumbang	15	25	623	68	716	6
Paete	16	43	23	0	66	5
Near Bay Island	17	7	547	6	560	14
Near Calamba Island	18	16	314	0	330	12
Between western side of Talim Island and Santa Rosa.	19	3	216	0	219	10
Between San Pedro and Diablo Pass	20	10	307	17	334	12
Muntinlupa	21	31	212	23	265	7
Binangonan	22	0	321	0	321	6
Darangan	23	11	242	3	256	5
Average		18	318	14		
Total		419	9,173	315		

The following data were used in the present computation of the population of *V. angularis* in Laguna de Bay:

Average number of *V. angularis* per square meter, 18.
Area accessible to kaladkad, 850 sq. km.
Computed *V. angularis* population, 15,300,000,000.
V. angularis consumed daily, 412,500,000.

According to Alonte (1930) *Vivipara angularis* attains sexual maturity at an average length of 19.08 millimeters and an average width of 15.11 millimeters at the age of 63 days. According to the normal expectation in biotic potentiality of organisms, at least one individual out of any given number of offspring reaches sexual maturity. A generation of *V. angularis* lasts about 63 days, so that approximately 5 generations are produced in one year. Thus within a year one snail will give rise to about 32 snails.

The population of *V. angularis*, 15,300,000,000, is divided into 63 lots of 242,900,000 individuals each. For 63 days at least 1 lot reaches sexual maturity per day. The daily withdrawal is also divided into 63 groups, each group assumed to be distributed among each lot of the entire population. Thus 6,560,000 *V. angularis* $\frac{(412,500,000)}{63}$ are assumed to be taken from each lot daily. By this assumption the consumption is allotted uniformly and the danger of rapid exhaustion of the snail population is avoided. But the daily consumption allotted to each group $\frac{(242,900,000)}{6,560,000}$ is contained 37 times in one lot, so that only the first 37 lots have to reproduce once in this present computation. The computation is therefore based on the remaining population of *V. angularis* after a lapse of 37 days.

Table 2 shows that on the first day lot 1 will be doubled, or 485,800,000 *V. angularis*. On the second day all the lots will be diminished by 6,560,000, and the population of lot 2 after reproduction is 472,680,000. From the same table, the population of each lot is given at maturity. The population of lot 1 after deducting the consumption for 37 days is 243,080,000 *V. angularis*, and the population of lot 37 on the 37th day is 6,920,000 so that on the 38th day this lot will be exhausted. The remaining 37 lots, which have reproduced once, will be exhausted after 11 days, because the total population of the 37 lots after 37 days is 4,625,490,000, and divided by 412,500,000 (daily quantity consumed) will give only 11 days. It is safe

to conclude, therefore, that 38 days after June 30, 1937, when the census of the snail population was taken, the population of *V. angularis* will be so small, almost reaching the zero point, that rehabilitation of this species is impossible, especially as long as the people persist on their present practice.

TABLE 2.—*Diminution of first 37 lots that have reproduced once.*

Lot.	Population at maturity.	Days before lot reproduces.	Population after reproduction.	Snails taken in 37 days.	Remaining snails after 37 days.
1	242,900,000	37	485,800,000	242,720,000	243,080,000
2	236,340,000	36	472,680,000	236,160,000	236,520,000
3	229,780,000	35	459,560,000	229,600,000	229,960,000
4	223,220,000	34	446,440,000	223,040,000	223,400,000
5	216,660,000	33	433,320,000	216,480,000	216,840,000
6	210,100,000	32	420,200,000	209,920,000	210,280,000
7	203,540,000	31	407,080,000	203,360,000	203,720,000
8	196,980,000	30	393,960,000	196,800,000	197,160,000
9	190,420,000	29	380,840,000	190,240,000	190,600,000
10	183,860,000	28	367,720,000	183,680,000	184,040,000
11	177,300,000	27	354,600,000	177,120,000	177,480,000
12	170,740,000	26	341,480,000	170,560,000	170,920,000
13	164,180,000	25	328,360,000	164,000,000	164,360,000
14	157,620,000	24	315,240,000	157,440,000	157,800,000
15	157,060,000	23	302,120,000	150,880,000	151,240,000
16	144,500,000	22	289,000,000	144,320,000	144,680,000
17	137,940,000	21	275,880,000	137,760,000	138,120,000
18	131,380,000	20	262,760,000	131,200,000	131,560,000
19	124,820,000	19	249,640,000	124,640,000	125,000,000
20	118,260,000	18	236,520,000	118,080,000	118,440,000
21	111,700,000	17	223,400,000	111,520,000	111,880,000
22	105,140,000	16	210,280,000	104,960,000	105,320,000
23	98,580,000	15	197,160,000	98,400,000	98,760,000
24	92,020,000	14	184,040,000	91,840,000	92,280,000
25	85,460,000	13	170,920,000	85,280,000	85,640,000
26	78,900,000	12	157,800,000	78,720,000	79,080,000
27	72,340,000	11	144,680,000	72,160,000	72,520,000
28	65,780,000	10	131,560,000	65,600,000	65,960,000
29	59,220,000	9	118,440,000	59,040,000	59,400,000
30	52,660,000	8	105,320,000	52,480,000	52,840,000
31	46,100,000	7	92,200,000	45,920,000	46,280,000
32	39,540,000	6	79,080,000	39,360,000	39,720,000
33	32,980,000	5	65,960,000	32,800,000	33,160,000
34	26,420,000	4	52,840,000	26,240,000	26,600,000
35	19,860,000	3	39,720,000	19,680,000	20,040,000
36	13,300,000	2	26,600,000	13,120,000	13,480,000
37	6,740,000	1	13,480,000	6,560,000	6,920,000
38	180,000	0	360,000		
	4,625,490,000				

KALADKAD

The frame of the kaladkad or dredge net is in the form of an isosceles triangle made of cast iron. The base is 3 feet long and the sides are 3.5 feet high each. About 6 inches above

the base and parallel to it is another iron bar, which, together with the base and the lower part of the sides, forms a regular trapezoid. Attached to the upper parallel iron bar and perpendicular to its plane is a rectangular board 5 inches by 24 inches which serves as a regulator of the pressure of the gear against the bottom of the lake during the process of hauling. Around the mouth of the trapezoid is attached a semicircular net (Aguinaldo Standard No. 1) which is in the form of a bag. The vertex of the triangle is provided with a loop where an abaca rope of about $\frac{3}{4}$-inch diameter is hooked. This rope, about 30 yards long, is used in towing the gear.

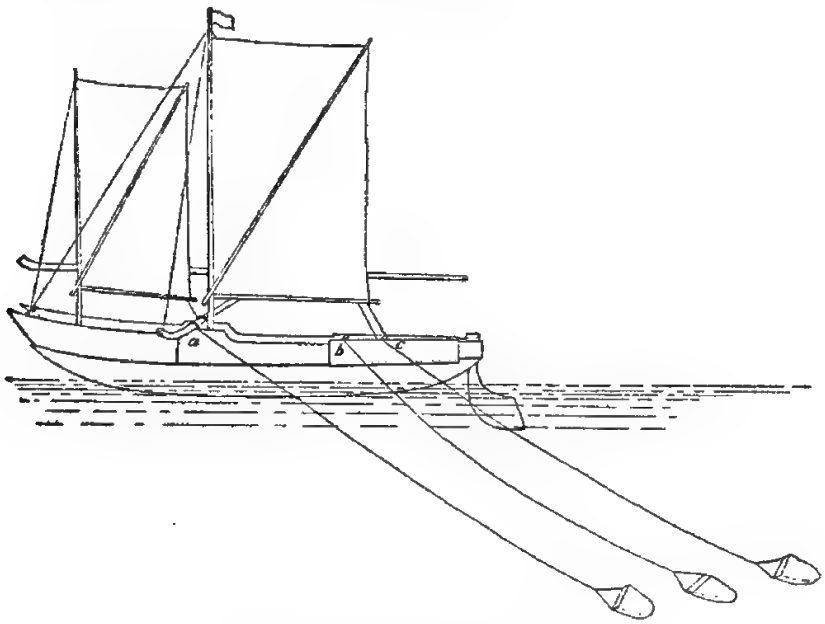

FIG. 3. Native dugout of the Laguna outrigger type.

The boats employed are the native dugouts or bancas of the Laguna-outrigger type with an average capacity of 12 kaengs of shells. They are about 12 yards long with a width of 4 feet and a depth of 3 feet. Each sailboat is usually manned by at least two men employing 2 to 3 dredge nets at a time. One man acts as the steersman, whose main duty is to direct the course of the sailboat. The other two men operate the dredge nets on the hold of the sailboat.

The end of the rope connecting one of the gear is tied around the bamboo crosspiece of the outrigger and the other two around

the two wood crosspieces set far apart on the stern hold of the sailboat (text fig. 3, *a*, *b*, and *c*). The gear are passed out into the water and hauling begins by setting on the sails. The gear are hauled when half full of snails. By pulling the rope every so often an experienced snail fisherman can easily determine

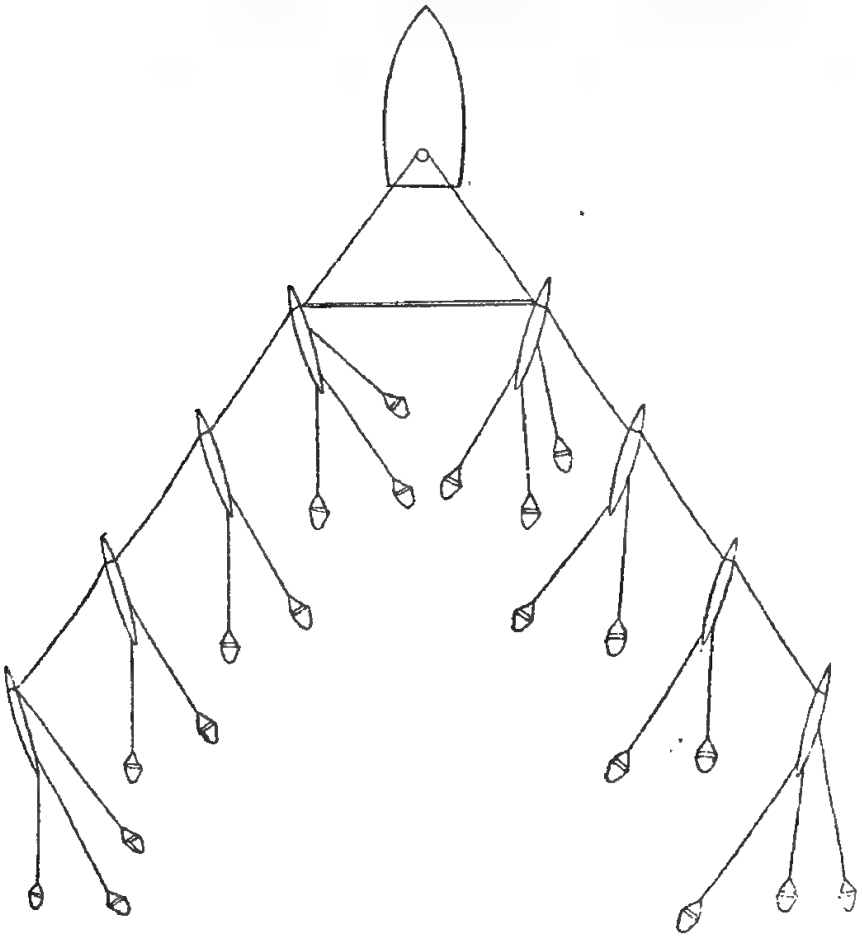

FIG. 4. Motor boat in the action of towing the sailboats each of which drags at least three dredge nets.

when to haul. The shells are cleansed of the mud before they are dumped into the sailboat and the operation is repeated until the required amount of snails is gathered. At least three to four hours are necessary to load a sailboat of a capacity of 12 kaengs.

Sails are used to propel the sailboat whenever the wind blows in a favorable direction. In calm weather the sailboat is propelled with man power—by paddle or by bamboo poles.

Nowadays motor power is used in gathering snails in Laguna de Bay. A motor launch tows from 20 to 30 sailboats, each of which drags at least 3 dredge nets. The sailboats are placed in two lines at intervals of 10 feet, and tied to the rear end of the motor boat. A beam stretched across the first two boats of each line keeps the two lines separate. In actual operation the two lines of sailboats assume an inverted V-shaped arrangement and all the dredge nets are dragged on the inner side of the two lines. This arrangement allows a uniform dredging of the area covered (text fig. 4), and prevents the intertwining of ropes and the passing of any dredge net over an area already hauled by another.

A drege net operated in connection with a motor boat is heavier to haul than one dragged by a sailboat operating alone. The speed of a sailboat may be momentarily slowed down by the lowering or loosening of the sail, which makes the hauling of the dredge net comparatively lighter. In a series of sailboats towed by a motor this is not possible. The motor boat must maintain a constant speed, because any slight slackening in speed will necessarily disturb the arrangement of the bancas as well as the dredge nets.

ILL EFFECTS OF THE KALADKAD

On the fauna of the lake in general.—Any body of fresh water, such as a lake, harbors a particular type of community of plants as well as species of animals or larvæ associated with them. Large plants serve as shelter and protection for aquatic larval stages of insects and larvæ of fishes and other lower forms of life of animals, while large animals feed on the smaller plants and animals at the bottom. As the entire bottom open to the kaladkad is scraped off often to a depth of about 2 to 4 inches, the growth of all kinds of plants and the various animals associated with them is greatly disturbed. Besides, many immature fishes are caught and destroyed with the snails. Among them are young of *biyang puti, Glossogobius giurus* (Gobiidæ); *kanduli, Arius* spp. (Ariidæ); *ayuñgin, Therapon plumbea* (Theraponidæ); and the *bañgayñgay, Ophiocara aporos* (Eleo-

tridæ). Crustaceans, fresh-water shrimps, and crabs are also represented in the catch of dredge nets.

Of the fishes mentioned, biyang puti probably suffers the greatest destruction. Newly spawned gobies, which are held in bunches by a gelatinous membrane and attached on the under surface of the mud caves, become detached and destroyed when the kaladkad passes over them.

On the snail fishery.—The amount of snails consumed by more than 300,000 ducks a day (7,500 kaengs, or 412,500,000 snails) is responsible, more than any other factor, for the rapid depletion of snails in Laguna de Bay. In addition to this big amount of *V. angularis* hauled in every day, four causes of less importance influence the scarcity of snails; namely, the kaladkad net used at present being a nonselective fishing gear, the amount of snails wasted in feeding, occurrence of polluted water (*masamang tubig*, Tag.) in various portions of the lake, and the entrance of saltwater into the lake through Pasig River.

The kaladkad, being a nonselective fishing gear, catches snails of all sizes. Even the smallest or newly spawned *V. angularis* are represented in the catch. The immature group of *V. angularis* noted in the catch of kaladkad are on the average 6 millimeters long and 3.56 millimeters wide. The smallest *V. angularis* was 3 millimeters long and 2.51 millimeters wide. This size is about that of a newly spawned *V. angularis*. The mesh opening of the net used is so small that immature individuals of almost all species of shells available in the lake are present in the catch. The catching of these immature snails is very destructive to the snail population, allowing it no chance to reproduce before being gathered.

Due to the insanitary system of storing the snails, more snails are wasted than are actually consumed by the flock. The water used in sprinkling the snails kept in *tiklis* is taken from the swimming pool of the flock. This water is highly polluted on account of the decayed snails and fæces of the ducks, so that instead of refreshing the snails it kills them suddenly. The snails easily rot on account of the insanitary condition of the duck pen. The ducks do not eat rotten snails. If decayed snails are accidentally taken in by the ducks because of hunger, ptomaine poisoning results. The high percentage of mortality among the ducks kept around the lake is primarily attributed to hunger and to the unhealthful condition of the duck pens.

Decayed snails have a very obnoxious odor. Often enormous

numbers of the larvæ and pupæ of flies are left undisturbed for a week in big heaps of rotten snails. Decayed snails serve as ideal breeding ground for flies. Serious outbreak of diseases may thus occur in the localities where ducks are raised.

The occurrence of polluted water in various portions of the lake spells death to the animal forms inhabiting Laguna de Bay. This condition usually occurs near the shore of the lake. During summer, when the water is low, various aquatic plants and organic matter rot along the shore. At the beginning of the rainy season these decayed plants and organic materials are washed off, causing water pollution in the locality. But the most serious cause of water pollution which results in the scarcity of the snail population is the rotting of *lia* (Tag.), a unicellular alga, *Clathrocystis aeruginosa* (Kützing) Henfrey. A very thick slimy cake of this alga is usually formed on the surface of the water during summer. Due to the heat of the sun it decays together with the smaller fishes and organisms. After the decomposition of the algæ the snails have been observed to float on the surface of the water. Polluted water can easily be detected by a very characteristic fœtid odor of the decomposing algæ.

Another factor affecting the snail population is the entrance of salt water into the lake through Pasig River. At high tide a big portion of the lake becomes brackish. A great number of dead *V. angularis* have been observed to float on the surface of the water due to the diffusion of salt water into the lake. According to experienced snail fishermen, *Melania* spp. are not affected by the occasional increase in salinity of the water in the lake.

On other fishing gear.—On account of the pronounced scarcity of snails procurable in the open portions of the lake, snail fishermen are prone to invade even the prohibited zones. Invasion of the shallower parts of the lake results very often in the destruction of fish corrals and bamboo fish traps. Damage to the bamboo fish traps cannot be avoided because their position under the water cannot be detected. As a result complaints have been filed against kaladkad fishermen, and there have been frequent quarrels between kaladkad fishermen and the owners of the fish corrals and bamboo fish traps. Frequent violations of the fishery laws are committed as long as there are snails procurable in the neighborhood of fish corrals and fish traps. The decrease in the catch of these fishing gear is claimed to

be due to the frequent snail fishing which tends to drive schools of fish away.

The gill nets and set lines (with baited hooks) are fishing appliances employed to catch fish at night. They are set in the lake from 2 P. M. to 6 P. M. and hauled in about 3 A. M. Because the kaladkad fishermen are hauling snails day and night, they are a menace to the gill nets and set lines. Very often these fishing gear are never recovered because they are towed several kilometers away from the place of setting. Gill nets and set lines hauled by a kaladkad are often destroyed or rendered useless.

USES OF SNAILS

There are three species of mollusks used as food by the people around Laguna de Bay; namely, *Corbicula manillensis*, *Ampullaria luzonica*, and *Melania asperata*. The people resort to eating these shells when the price of fish is extraordinarily high. Snails also serve as food for the fishes caught in commercial quantities in the lake. According to Mane (1929) snails rank second in importance among the food of kanduli. In most instances the alimentary canals of commercial fishes have been found to contain nothing but snails and, with the present scarcity of snails, it is feared that the natural food of the fishes in the lake has been greatly reduced. Snails are also used as bait in fishing. In some cases, too, lime is manufactured by burning the shells of *Melania asperata*.

But the most important use of snails in Laguna de Bay is as food for the native ducks. They represent about 90 per cent of the daily diet of the ducks kept around the lake. The progress of the duck industry is at present determined only by the availability of a good supply of snails. The duck industry is bound to decline if the people continue to refuse to look for and buy feeds other than the snails whose supply is now very limited. Duck raisers still persist in the belief that the snails arise spontaneously and cannot be depleted even in the face of the present scarcity. They also have the notion that snails are the only right kind of feed for their flocks. They have altogether disregarded the importance of other protein supplements, such as shrimp and fish meals. Their failure to provide adequate food for the ducks is responsible for the poor supply of eggs in the local markets.

NECESSITY OF FISH-PROTEIN SUPPLEMENT IN THE DIET OF DUCKS

In order to maintain a regular supply of duck eggs, other protein supplements must be introduced. Cruz (1932) reported that snail-fed ducks consume the most feed and are the most expensive to raise. On the other hand, in the ducks which are given protein supplement other than that derived from snails, the production of eggs is more or less controlled. Ducks fed with other protein supplement lay eggs regularly throughout the year.

Fronda and Mencias (1937) reported that the eggs of ducks that depend upon snails for protein supplement in the feed have yolks that are deep orange in color. It is an accepted fact that snail-fed ducks produce eggs with very fishy flavor. In the experiment conducted by Fronda and Mencias (1937) the taste and color of the eggs obtained from ducks fed with mash mixture (see below) compare favorably with chicken eggs. The different kind of mash mixtures are given in Table 3.

TABLE 3.—*Mash mixtures given to ducks by Fronda and Mencias.*

Feeds used.	Lot 1.	Lot 2.	Lot 3.	Lot 4.
	Kg.	*Kg.*	*Kg.*	*Kg.*
Shrimp meal	20.0			
Fish meal		20.0	30.0	40.0
Corn meal	20.0	20.0	17.5	15.0
Rice bran	60.0	60.0	52.5	45.0
Price per 100 kg., in pesos	6.31	5.00	5.75	6.31

To every kilogram of each of the mash mixtures one kilogram of common table salt and two kilograms of ground shells were added. Chopped green grass was added to each lot morning and afternoon. The feed was given four times a day. The ducks were given at each feeding time as much feed as they were able to consume in 20 minutes. According to the experiment, the only water accessible to the ducks at all times was drinking water which was changed four or five times a day. The ducks laid eggs regularly throughout the year. The most economical production of eggs was that of lots 2 and 3, where the cost of feeds needed to produce a dozen eggs was 19 and 23 centavos, respectively. The above mash mixture is at present highly recommended to restore the duck industry around Laguna de Bay.

The duck industry cannot be restored to its former status unless the snail fishery in Laguna de Bay is rehabilitated. Re-

habilitation can only be attained by feeding the ducks in the meantime with protein supplement, such as the mash mixture formulated by Fronda and Mencias in 1937. The duck raiser's only alternative now is to buy protein supplement or abandon the industry.

Duck raisers still consider snails the best feed for ducks. As a matter of fact, the Pateros duck raisers are at present gathering marine species of snails in the vicinity of Malabon and Navotas, Rizal Province. Like the conditions existing at present in Laguna de Bay, the supply of snails in these localities is also limited, so that the cost of producing eggs per unit weight of snail food is extraordinarily high.

SUMMARY AND CONCLUSION

In order to avoid the decline of the duck industry proper conservation of the snail fishery in Laguna de Bay is urgently recommended. Only a limited number of the ducks should be kept and maintained to balance the probable yield of the snails in the lake.

The kaladkad system of snail fishing is very destructive to the fauna of the lake in general, to the snail fishery, and to the other fishing gear employed to catch fish in the lake. The kaladkad net used catches snails of all sizes found in Laguna de Bay. The harmful effect of the kaladkad on the snail fishery, together with the big amount of snails consumed by the ducks every day, are responsible, more than any other factor, for the rapid depletion of snails in the lake.

Snail-fed ducks are expensive to raise. Moreover, duck raisers are not dependent upon snails alone to carry on the enterprise profitably. A more economical feed for egg production should be introduced. Fish protein supplement if given at the rate of 20 to 30 per cent gives the best returns on the cost of feed consumed.

RECOMMENDATIONS

1. That the mesh openings of the kaladkad net be standardized. Every kaladkad fisherman should use the Aguinaldo Standard No. 5.

2. That no kaladkad fisherman be allowed to gather snails at night, in order to give a chance to other fishermen to employ gill nets and set lines.

3. That no fisherman be allowed to gather snails within 200 meters from the fish traps (fish corrals) and 100 meters from bobos to avoid disturbance and damage done to these gear.

4. That only sufficient snails be given to the flock, and the excess supply be placed under water to avoid rotting and decay. Rotting snails must be carefully buried.

5. That no kaladkad be operated at any time of the year in the waters east of Talim Island. This side, belonging to the Municipal waters of Cardona, Jalajala, and Pililla, Rizal Province, is considered the best breeding ground of the commercial food fishes inhabiting Laguna de Bay.

6. That supplementary feed be introduced to obtain the best returns on the feed consumed. Supplementary feed will also improve the eating quality of the eggs.

ILLUSTRATIONS

TEXT FIGURES

THE OCCURRENCE OF FUGACIOUS CAMBIUM IN THE RHIZOME OF CURCUMA LONGA LINNÆUS

By DHIRENDRA NATH CHAKRAVERTI

Of the Botany Department, Carmichael Medical College, Calcutta

TWO PLATES

The rhizome of *Curcuma longa* Linn., of the Zingiberaceæ, shows a cambial activity limited to a very short length of its apical part. Similar fugacious cambium has been recorded by Skutch(7) in the bulb of banana, of the Musaceæ "whose chief function is the origination of the adventive roots and the vascular bundles which link them with the leaf-trace bundles."

To determine the occurrence of fugacious cambium in the rhizome of *Curcuma longa*, old rhizomes of this plant with terminal and lateral buds were kept under moist sawdust for some days. At the end of this period the rhizomes were found to have resumed their growth, and roots had appeared at the base of the lateral buds. These buds were cut off and fixed, some in stock chromoacetic solution, and others in the fixative named "Craf" by Randolph.(5) Materials fixed in stock chromoacetic solution were washed in water, dehydrated in dioxan, and embedded according to Maheswari's review of T. T. Baird.(4) Materials fixed in "Craf" were directly immersed in 75 per cent alcohol, and then dehydrated and embedded in the usual way. Microtome sections in transverse and longitudinal planes were cut 6 to 10 μ thick and stained in safranin and Delafield's hæmatoxylin.

Examination of the sections showed that an undifferentiated meristem marks the extreme apex of the rhizome of *Curcuma longa*, at a little lower level of which some rudimentary primary vascular bundles appear mostly in a ring (Plate 1, fig. 1), together with many older cortical (leaf-trace) bundles on the outside (Plate 2, fig. 2). Soon after the development of the primary vascular cylinder is completed, some of the pericyclic cells at different places undergo one or more periclinal divisions, forming strips of fugacious cambium which may vary from two to four layers of cells. All these strips taken together make up

about three-fourths of the circumference of the section, with occasional interruptions for the passing out of the radially extending leaf-trace bundles (Plate 1, fig. 2). This cambium produces secondary vascular bundles on its inner side only and is found, as thought by Cheadle,(2) to be associated with the production of adventive roots (Plate 1, fig. 3), thus linking the vascular bundles of adventive roots with those of the stele of the rhizome as in the case of the banana.(7, p. 235, fig. 1) The duration of this fugacious cambium is very short; it soon disappears almost abruptly, leaving behind a definite ring which Engler and Prantl(3) refer to as "Die stark in die Augen springende Kreislinie," consisting of a weft of crowded bundles, the output of secondary growth (Plate 2, fig. 3). This ring is observed even with the unaided eye throughout the older portion of the rhizome when the rhizome is cut into thin pieces or slices. The crowded arrangement of the secondary vascular bundles and their distribution in a ring clearly distinguish them from the primary vascular bundles which are loosely arranged and scattered. Similar crowded secondary vascular bundles were recorded by Scott and Brebner(6) in the stem of *Aristea corymbosa* Benth. of the Irideæ.

The primary vascular bundles are closed and collateral (Plate 1, fig. 4) but of the secondary vascular bundles some are collateral (Plate 1, fig. 5) while others are amphiphloic (Plate 1, fig. 6). The sclerenchymatous ring is absent in both the primary and secondary bundles. In size the primary and secondary vascular bundles are variable (Plate 2, fig. 3). In transverse sections oblique and even some longitudinal bundles appear amongst the secondary vascular bundles. The formation of periderm also takes place, but it is very superficial.

Buds arise exogenously at the axils of scaly leaves of the rhizome; in serial transverse sections the peripheral vascular bundles of the axillary buds pass gradually towards the center through the cortex till they become arranged in the same ring of secondary vascular bundles of the rhizome, and thus the circular stele (Plate 1, fig. 1; Plate 2, fig. 2) takes up an oval outline (Plate 1, fig. 2; Plate 2, fig. 3).

In some arboreal forms amongst monocotyledons Arber(1) has recorded a form of cambial thickening which, though differing widely from that of dicotyledons, is yet competent to

[1] Die Nat. Pflanzenfamilien II 6 (1899) 13.

produce secondary growth; it was found in *Aloe, Cordyline, Dasylirion, Dracaena, Kniphofia, Nolina, Yucca, Xanthorrhoea, Agave, Furcraea, Aristea* and related genera, *Testudinaria, Tamus,* and *Dioscorea.* But this cambium was of permanent nature, unlike the fugacious cambium in the rhizome of *Curcuma longa.*

ACKNOWLEDGMENT

This work was carried out under the direction of Dr. S. R. Bose, Professor of Botany of Carmichael Medical College, to whom I am obliged for helpful suggestions and useful criticism.

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ILLUSTRATIONS

PLATE 1

FIG. 1. Rudimentary primary vascular bundles, *pvb*, in a ring around the central ground tissue, *gt*; × 208.

2. Strips of fugacious cambium, *f cam*, secondary vascular bundles of varying shape, *svb*, two spiral vessels, *v*, one vascular bundle, *vb*, passing longitudinally, and endodermis, *en*; × 200.

3. Origin of root, *r*, and secondary vascular bundles, *svb*, from fugacious cambium, *f cam*, in the middle, and very young secondary vascular bundle, *ysvb*, developing from cambium; × 244. Reconstructed from two slides.

4. Closed collateral primary vascular bundle. Xylem, *x*, phloem, *ph*, and protoxylem, *pr x*; × 220.

5. Closed collateral secondary vascular bundle. Xylem, *x*, and phloem, *ph*; × 200.

6. Amphiphloic secondary vascular bundle. Xylem, *x*, phloem, *ph*, and endodermis, *en*, with casparian strips; × 240.

PLATE 2

FIG. 1. Strips of fugacious cambium, secondary vascular bundles, spiral vessels, and endodermis. Eye piece 15 x and low-power objective 16 mm; original photomicrograph reduced to ⅔.

2. Central ground tissue, *gt*, with a ring of rudimentary primary vascular bundles, *pvb*, and older leaf traces, *lt*, on the outside, two leaf bases, *lb*, attached to the central stem, and small gaps, *g*, at extremity of leaf base. Eye piece 10 x and low-power objective 16 mm; original photomicrograph reduced to ⅔.

3. Secondary vascular bundles, *svb*, just inside the endodermis, *en*, arranged in a ring, primary vascular bundles, *pvb*, lying in the middle.

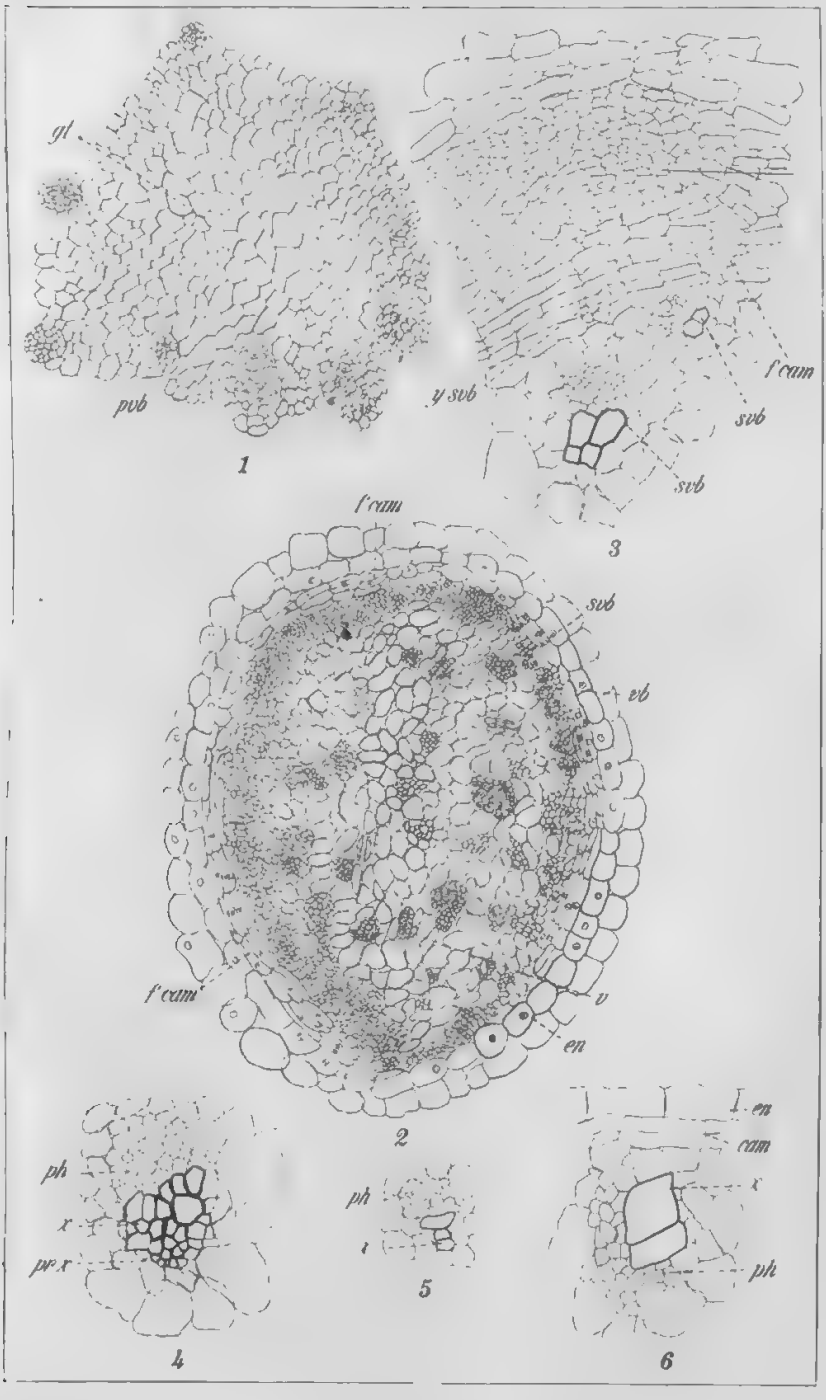
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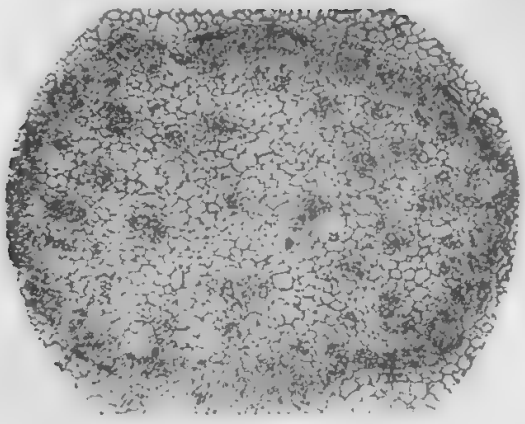
PLATE 1.



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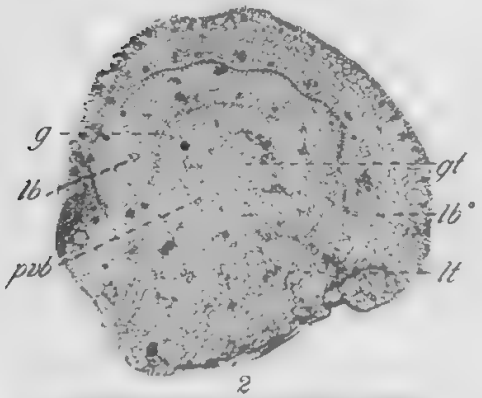

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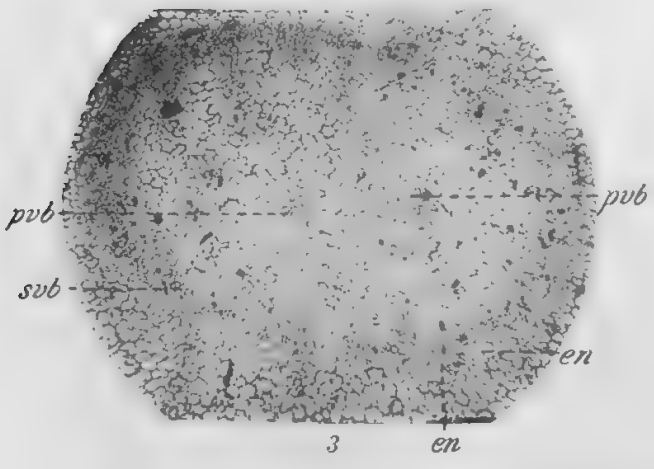

3

PLATE 2.

ROASTING OF PHILIPPINE LOW-GRADE CHROMITE FOR THE PRODUCTION OF SODIUM BICHROMATE [1]

By V. G. LAVA and I. OLAYAO
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FOUR TEXT FIGURES

A deposit of chrome ore, estimated to consist of at least eight million tons, is located in the Masinloc district, Zambales Province, Philippine Islands. In view of the large available quantity of this chromite, experiments were carried out by the present authors, partly in the laboratory of Consolidated Mines and partly in the Bureau of Science, to determine the best conditions for roasting the ore for the production of sodium bichromate. The results are recorded in this paper.

The production of bichromate by roasting chromite has been practiced since the early part of the 19th century,(1) when saltpeter was used for the oxidation of the ore. Around the middle of the century an improvement was made in the process by the introduction of the use of potassium carbonate, and by passing air over the mixture(8) while the latter was being heated for purposes of oxidation. Since then, many other methods have been tried, involving the following features:

(*a*) The substitution of alkali-earth compounds for the alkali carbonate used during the roasting process;
(*b*) the substitution of other cheaper alkali salts for the alkali carbonate;
(*c*) the dilution of the roasting mixture in order to effect more complete oxidation by air, by the addition of fairly inert materials;
(*d*) the decrease of the time and the increase of efficiency of roasting by improvements in mechanical features; and
(*e*) the decrease of the temperature of roasting.

A few examples may be given to illustrate these variations. In Jacquelain's process(9) the ore was roasted with lime in a reverberatory furnace at bright-red heat for 8 to 9 hours, and with ten to twelve rabblings during the roasting process. The

[1] Published with the permission of Mr. V. Elicaño, Technical Director and Vice-President, Consolidated Mines, Incorporated, Manila. Delivered at the Fifth Philippine Science Convention, February 21 to 26, 1939. Received September, 1938.

roast was decomposed with sulphuric acid to convert the insoluble calcium chromate into the soluble calcium bichromate. The solution was then heated with an emulsion of chalk to neutralize the excess acid and to precipitate the ferric salts together with the alumina and magnesia contained in the ore. After filtering, a solution of potassium carbonate was added to the filtrate to convert the calcium bichromate into potassium bichromate, and the calcium carbonate was separated by filtration. The potassium bichromate solution was then crystallized in the usual way. By this method the amount of alkali carbonate required to produce the dichromate was reduced to a minimum; or, lead chromate could be obtained without the use of the alkali salt. The great drawback of this method is that the recovery of bichromate is low.

In one of Tilghman's patents(14) potash feldspar or alkali sulphate was mixed with the ore and quicklime and the mixture roasted. In another patent potassium sulphate or potassium chloride was used in the roasting mixture together with steam in the roasting atmosphere.

In Swindell's patent(12) calcium or sodium chloride was used together with steam.

Gorman(7) roasted a mixture of ore and lime at a high temperature, then added potash, soda, or potassium sulphate and roasted again at 600° C.

In Römer's patent(10) soda was substituted for one equivalent of potash in the roasting mixture, and after sulphuric acid was added to the concentrated liquor, the potassium bichromate was precipitated, leaving the sodium sulphate in solution.

Some catalysts or diluents, such as coke and the oxides of manganese, copper, and iron were also used. Thus Wise(16) replaced a large proportion of the lime in the usual ore-lime-soda mixture by ferric oxide and magnesium oxide obtained as residue of a previous calcine. Drefahl(3) used a mixture of ore, lime, soda, and coke or charcoal in the ratio of 1 : 1.10 : 0.86 : 0.67, and blast-roasted in a sintering roaster.

Lime was also replaced by such substances as bauxite(11) or dolomite,(18) and the Russian workers,(17) working with Ural chromite of 40 per cent chromic oxide, obtained almost complete extraction with a mixture of ore, soda, and dolomite in the ratio of 1 : 0.8 : 0.8.

To prevent any loss of chromium, various patents have been taken in which the residue from the calcine which still con-

tains undecomposed ore together with the iron oxide, alumina, and magnesia, is mixed with fresh ore.(4)

Various patents have been issued for improvements in mechanical features. In Fuller's patent(5) the ore-lime-soda mixture was roasted in an automatically rabbled furnace by allowing the mixture to travel first through a zone of temperature higher than the soda fusion point and then through a zone of temperature lower than the fusion point. In Gibb's process(6) the addition of lime was altogether eliminated by roasting the ore-soda mixture in a revolving furnace at a temperature sufficient to keep the charge fluid.

Zahn and Company(19) claim certain advantages in roasting first with insufficient soda, and after leaching the calcine, roasting again with more lime and soda.

PRESENT PRACTICE IN THE MANUFACTURE OF BICHROMATE

The usual procedure in the manufacture of bichromate may be briefly described thus:(15) The ore is dried by waste furnace gases, crushed in a jaw crusher, then ground in a ball mill with a 130-mesh discharge, and stored in bins. From bins of ore as well as of the ground lime and soda ash, measured quantities of each are weighed and thoroughly mixed, first in a ball mill and finally in a Krupp mixer. The mixture is then roasted in a reverberatory furnace heated to from 800° to 1200° C. A mechanical furnace which has a revolving circular hearth of 6 meters diameter has a capacity of 2,500 kilograms and requires eight hours to roast.

The calcine is then transferred to a battery of iron tanks provided with false filter bottoms and leached with hot water, the most concentrated liquor being pumped to another tank filled with fresh calcine, until a 30° to 40° Be liquor is obtained. As calcium chromate is frequently present in the liquor, the latter is first transformed to alkali salt by addition of a measured quantity of the alkali carbonate and heating at a temperature higher than 100° C.(4) After filtration the liquor is concentrated to 50° Be, from which sodium chromate may be crystallized. Or the concentrated liquor may be treated with sulphuric acid, the sodium sulphate which crystallizes out then being removed by centrifuging or filtering by suction, and the bichromate liquor finally crystallized and dried, or dehydrated by heating in cast-iron vessels and crystallized from the molten state.

In the United States only high-grade chromite is used for roasting, probably because results of investigations show that with low-grade ores the percentage recovery based on the chromic oxide content of the ore is low. Thus Doerner's report(2) shows that low-grade ore requires more reagents to effect adequate conversion to chromate, and that less of the chromate is extracted by water leaching than with a high-grade ore—a 56 per cent chrome ore requiring 200 per cent lime and 140 per cent sodium carbonate to give a 97 per cent extraction, and a 43 per cent chrome ore requiring 200 per cent lime and 140 per cent sodium carbonate to give only 92 per cent extraction.

Our experiments show that with Philippine chromite of 33 or 37 per cent chromic oxide content only 85 to 90 per cent sodium carbonate is necessary, much less lime (10 to 25 per cent) is needed, and the water extraction can be raised to as high as 100 per cent.

EXPERIMENTAL PROCEDURE AND RESULTS

The ore used for investigation was the Masinloc ore from Zambales Province, owned by Consolidated Mines, Incorporated. Its chemical composition is given in Table 1.

TABLE 1.—*Composition of chrome ore from Masinloc, Zambales Province.*

Constituents.	Ore.	
	Crude.	Concentrated.
	Per cent.	*Per cent.*
SiO_2	5.6	1.8
Fe_2O_3	17.9	18.5
Al_2O_3 (by difference)	26.2	25.9
Cr_2O_3	33.5	37.6
MgO	16.8	16.2
CaO	trace	trace
Ti	trace	trace
V	trace	trace

This ore is closely associated with peridotite or pyroxenite intrusions, and occurs in lenticular masses of varying size apparently accumulated near the border of the peridotite intrusions. The ore mineral shows a crystalline texture usually of coarse, but sometimes of fine, grain, although massive or amorphous textures have also been observed. Conservative estimates of the tonnage of the chromite reserves in Masinloc show that there are at least 8,000,000 tons of this ore available.

In view of this abundance of the ore and of its fairly low chromic oxide content which tends to confine its usefulness to refractory purposes only, studies were made to determine whether Masinloc ore can compete with higher grade ores in the world market. The present research is a part of the above general investigation, and has for its specific object the determination of the optimum conditions for roasting Masinloc chromite for bichromate manufacture.

The ore was first ground to −150 mesh, and 2 grams mixed thoroughly with different reagents before roasting. Both platinum and porcelain crucibles were used, the latter being just as good as platinum crucibles if used not more than three or four times. The temperature of the furnace was read with a pyrometer. After a definite time of roasting the calcine in the crucible was placed in about 100 cc of water, heated to boil, and filtered, this operation being repeated three or four times. The residue was diluted with water, dilute hydrochloric acid added, and the mixture heated to make soluble whatever hexavalent chromium may have been left. Both the water extract and the acid extract were assayed for their chromate content with a standard solution of sodium thiosulphate.

Table 2 shows the results of preliminary runs with unconcentrated ore. Experiments 1 to 4 show that with no lime and with the soda-ash (93.5 per cent pure) content varying from 50 to 100 per cent, when the temperature of roasting is about 1,000° C. there is complete fusion of the mixture and a consequent low recovery. The fact that the ore was completely attacked except in experiment 4, as shown by the complete solubility in hydrochloric acid solution of the residue from the calcine, would indicate that the chromic oxide in the ore was transformed into some other compound in which the chromium was not hexavalent. When 25 per cent lime is used (experiments 5 to 8) under conditions similar to those obtaining in experiments 1 to 4, greater recovery is obtained both in the water extract and in the total extract; also, fusion is not as complete. When 75 per cent lime is used (experiments 9 to 11), still higher recoveries are obtained from mixtures of 80 per cent sodium carbonate down, but a low recovery is obtained when 100 per cent soda ash is used. This relation is greatly magnified when 125 per cent lime is used (experiments 12 to 14). A comparison of the total recoveries in experiments 1 to 4 show that while with no lime the total recovery is a linear

function of the soda ash used, this relation also obtains when 25 per cent lime is used; above 25 per cent lime total recovery is almost the same, irrespective of the soda ash used; in fact, with a quantity of soda ash above 80 per cent the total recovery is even less than with a quantity of soda ash below 80 per cent.

In all the experiments cited, 5 per cent ferric oxide was used. The effect of this substance is shown in experiments 15 to 17. It is to be noted that when both lime and soda ash are used in quantities over 100 per cent, the iron oxide has the effect of increasing both the water recovery and the total recovery.

As Table 2 showed that a total recovery of over 90 per cent could be obtained by the use of a great quantity of lime and less soda ash, an attempt was made to use this type of combination under different conditions of temperature, time of roasting, and mode of exposure. Table 3 shows effects of these factors. It is evident from this table that while between 800 and 830° C. there is no fusion of the mixture, the rate of oxidation is fairly low and the time of roasting has to be increased; on the other hand, there is no great advantage gained by a temperature much higher than 850° C., since both the water recovery and total recovery at 1000° C. are less than the corresponding recoveries at 850° C. Also, while at temperatures below 850° C. the rate of oxidation is low, at 850° C. and above the oxidation reaches its maximum between three and six hours.

From experiments 15 to 19 quenching seems to have the effect of accelerating oxidation, but, as will be shown later, produces a mechanical loss in chromate recovery. It will be observed that a sodium-carbonate content equivalent to 70 per cent of the ore gives as much total recovery as an equivalent to 80 per cent, although the water extract is slightly less in the 70 per cent soda-ash mixture.

With these mixtures containing 70 to 80 per cent soda ash in no case was the water recovery higher than 88 per cent, nor the total recovery higher than 95.5 per cent. Considering that in order to convert the water-soluble chromate into the soluble form, either further addition of soda ash to the residue from the water extraction is necessary, or carbon dioxide has to be passed through the suspension of the residue, no great advantage would be gained by the use of very much lime and a comparatively small amount of soda ash, over a small amount of lime and a slightly greater quantity of soda ash, as is shown by experiment 5 in Table 2.

TABLE 2.—*Preliminary experiments showing the effects of temperature and of varying quantities of lime, soda ash, and ferric oxide on the roasting of Masinloc chromite.*

[Samples were placed in the furnace only when the temperature was about 850°C.]

[Unconcentrated chromite, 2 grams.]

Experiment.	Time.	Lime.	Soda ash.	Ferric oxide.	Average temperature.	Recovery.			Remarks.
						Water soluble.	Hydrochloric acid soluble.	Total.	
	Hours.	*g.*	*g.*	*g.*	*°C.*	*Per cent.*	*Per cent.*	*Per cent.*	
1	3	0	2.0	0.1	*1000	89.5	trace	89.5	Caking in all. Ore completely attacked except in experiment 4.
2	3	0	1.6	0.1	1000	73.1	trace	73.1	
3	3	0	1.4	0.1	1000	66.0	trace	66.0	
4	3	0	1.0	0.1	1000	49.0	trace	49.0	
5	4	0.5	2.0	0.1	*1000	95.7	0.4	96.1	Soft caking in all. Ore completely attacked.
6	4	0.5	1.4	0.1	1000	76.5	0.8	77.3	
7	4	0.5	1.2	0.1	1000	67.7	0.4	68.1	
8	4	0.5	1.0	0.1	1000	63.4	1.3	64.7	
9	3	1.5	2.0	0.1	930	86.7	3.7	90.4	Ore completely attacked.
10	3	1.5	1.6	0.1	930	87.4	4.2	91.6	
11	3	1.5	1.2	0.1	930	77.3	5.7	83.0	
12	3	3.5	2.0	0.1	960	66.3	18.7	85.0	Fusion. Ore completely attacked.
13	3	2.5	1.6	0.1	960	86.8	7.5	94.3	
14	3	2.5	1.4	0.1	960	83.8	10.5	94.3	
15	3	2.5	1.2	0.1	960	80.5	9.0	89.5	Ore not completely attacked. Fusion.
16	3	2.5	1.0	0.1	960	77.5	9.0	86.5	
17	3	2.8	2.8	0	*1000	76.2	14.1	90.3	Do.
18	3	2.8	2.8	0.2	1000	79.2	14.1	93.3	
19	3	2.8	2.8	0.4	1000	89.0	11.2	100.2	

* Approximate.

TABLE 3.—*Effect of the mode of exposure of large quantities of lime with varying amounts of soda ash on the roasting of Masinloc chromite.*

[Unconcentrated chromite, 2 grams.]

Experiment.	Time.	Lime.	Soda ash.	Average temperature.	Recovery.				Remarks.
					Water soluble.	Hydrochloric acid soluble.	Total.	Residue.	
	Hours.	*g.*	*g.*	*°C.*	*Per cent.*	*Per cent.*	*Per cent.*	*g.*	
1	2.0	2.8	1.6	1000	77.5	9.2	86.7	----------	All crucibles were placed when furnace was at 850 °C. Ore completely attacked. All mixtures fused.
2	4.0	2.8	1.6	1000	82.0	11.1	93.1	----------	
3	6.0	2.8	1.6	1000	85.3	7.5	92.8	----------	
4	4.0	2.8	1.6	1000	81.5	11.9	93.4	----------	
5	[a]6.0	2.8	1.6	1000	86.2	5.2	91.4	----------	
6	3.1	2.8	1.6	1000	86.3	5.3	91.6	----------	
7	1.1	2.8	1.6	1030	82.4	6.8	89.2	----------	
8	1.1	3.6	1.6	1030	82.8	5.1	87.9	----------	
9	2.0	2.8	1.6	850	82.8	9.7	92.5	----------	In all cases there was a white yellowish layer over a green layer. Ore completely attacked. All mixtures not fused.
10	4.0	2.8	1.6	850	88.0	7.5	95.5	----------	
11	6.0	2.8	1.6	850	87.0	6.6	93.6	----------	
12	[a]6.0	2.8	1.6	850	84.0	6.9	90.9	----------	
13	4.0	2.8	1.4	850	84.7	8.7	93.4	----------	
14	3.8	2.8	1.4	860	86.0	7.4	93.4	----------	
15	2.0	2.8	1.6	800	38.7	16.8	55.5	0.52	Two layers not distinct. Ore not completely attacked. All mixtures not fused.
16	4.0	2.8	1.6	810	41.0	20.8	61.8	0.37	
17	[b]6.0	2.8	1.6	830	53.9	7.9	61.8	0.06	
18	4.0	2.8	1.4	810	45.0	15.3	60.3	0.39	
19	[b]6.0	2.8	1.4	830	62.0	9.5	71.5	0.07	

[a] Left overnight in furnace.

[b] Quenched once after 4 hours.

Accordingly attention was focused on the possibilities of using only a little lime and amounts of soda ash greater than 80 per cent of the ore—a plotting of the soda-ash-water recovery curve from experiments in Table 2 indicating that over 95 per cent water extraction is possible with 90 to 95 per cent soda ash. In previous experiments the difficulty appeared to be due to a deficiency in oxidation as a result of the fusion of the mixture. If this be so, the difficulty can be overcome by a comparatively low temperature exposure and by the addition of substances that would create a porous structure in the roasted mixture. Accordingly several substances, like sawdust, bagasse, iron oxide, and rice hulls were tried.

Table 4 shows the effect of the addition of these substances to roasting mixtures of varying lime and soda ash contents. Experiments 3, 6, and 19 show that in a mixture of 25 per cent lime and 95 per cent soda ash the addition of 50 per cent rice hull, ground to −60 mesh, will produce a water extraction of 97 per cent or over, while without rice hulls an extraction of only 90 per cent is possible (Experiment 1). If lime is completely eliminated, however, water extraction gives only 90 per cent recovery as shown by Experiment 12 (Table 4). The addition of 30 per cent or even 15 per cent instead of 50 per cent rice hulls has possibilities, as is shown by Experiments 20 and 21. Sawdust and bagasse, ground to −60 mesh, also seem to be very effective, as Experiments 22, 25, and 30 show; coked rice hull, bagasse coke, and bagasse ash, however, are not effective, as shown by Experiments 10, 17, and 18.

The use of 15 per cent lime is evidently sufficient. With this amount no carbonaceous agent is necessary to give a 100 per cent water recovery (Experiment 39) while amounts of iron oxide from 10 to 20 per cent or 25 to 75 per cent sawdust do not lower the recovery (Experiments 32 to 38). It is thus clear that while carbonaceous agents play an important rôle in the roasting of chromite, the most important factor is the lime concentration of the roasting mixture.

In these experiments and in others to follow optimum conditions of recovery are always associated with calcines which are porous and greenish.

The case of roasting the concentrated ore is only slightly different. Tables 5 and 6 show the recovery of chromium as chromate under different conditions of soda-ash content, liming, and diluting agents. Experiments 1, 7, and 15 (Table 5)

TABLE 4.—*Effect on the roasting of Masinloc chromite of small quantities of lime with varying quantities of soda ash and other substances.*

[Unconcentrated chromite, 2 grams.]

[Samples placed in furnace when cold.]

Experiment.	Time.	Lime.	Soda ash.	Other reagents.	Average temperature.	Recovery.			Residue.	Remarks.
						Water soluble.	Hydrochloric acid.	Total.		
	Hours.	*g.*	*g.*	*g.*	*°C.*	*Per cent.*	*Per cent.*	*Per cent.*	*g.*	
1	4	0.5	1.9	None	930	90.2	1.5	91.7	0.12	
2	4	0.5	1.0	Rice husk	930	63.0	1.2	64.2	0.62	Not completely fused.
3	4	0.5	1.9	1.0 ground ipa (—60m)	930	97.5	0.2	97.7	0.11	All quenched 2 hours before completion.
4	4	1.5	1.9	None	930	43.6	21.6	65.2	0.42	
5	4	1.5	1.0	do	930	63.4	9.7	73.1	0.20	
6	4	0.5	1.9	1.0 ground ipa (—60m)	930	97.0	0.3	97.3	0.16	
7	4	0.5	1.5	do	930	81.1	0.4	81.5	0.56	
8	4	0.5	1.0	do	930	52.3	0.7	53.0	1.11	Melted on sides of platinum.
9	4	0.5	0.5	do	930	31.2	2.3	33.5	1.33	Quenched 2 hours before completion.
10	4	0.5	1.9	1.0 coked ipa (—60m)	930	68.8	11.6	80.4	0.58	
11	4	0.5	1.9	0.5 ground ipa (—60m)	930	93.5	0.6	94.4	0.20	
12	3.8	0	1.9	1.0 ipa (—60m)	860	90.0	0.2	90.2		
13	3.8	0	1.5	do	860	67.8	0.2	68.0		
14	3.8	0.5	1.5	do	860	79.8	0.1	79.9		No fusion except in experiment 16. Quenched 2 hours before completion.
15	3.8	1.0	1.5	do	860	52.3	15.5	67.8		
16	3.8	1.5	1.5	do	860	40.3	33.3	73.6		
17	3.8	0.5	1.9	1.0 bagasse coke	860	91.0	0.2	91.2		
18	3.8	0.5	1.9	1.0 bagasse ash	860	63.2	0.1	63.3		
19	3.8	0.5	1.9	1.0 ground ipa (—60m)	870	98.0	trace	98.0		Hard cake.
20	3.8	0.5	1.9	0.6 ipa (—60m)	870	100.0	trace	100.0		Less hard cake. Not quenched at all.
21	3.8	0.5	1.9	0.3 ipa (—60m)	870	100.0	trace	100.0	only SiO_2	Soft, and porous cake.
22	3.8	0.5	1.9	1.0 sawdust (—60m)	870	97.0	1.4	98.4		Do.
23	3.8	0.5	1.9	0.3 sawdust (—60m)	870	96.6	1.5	98.1		Do.
24	3.8	0.5	1.9	1.0 bagasse (—60m)	880	100.0	trace	100.0		Do.

25	3.8	0.5	1.9	1.0 sawdust (—60m)	870	98.5	1.8	100.3	----------	Dark green, porous.
26	3.8	0.5	1.5	2.0 sawdust (—60m)	870	85.8	1.7	87.5	----------	Brown, porous.
27	3.8	0.5	1.5	1.5 sawdust (—60m)	870	87.5	1.4	88.9	----------	Do.
28	3.8	0.5	1.5	1.0 sawdust (—60m)	870	87.5	0.8	88.3	----------	Do.
29	3.8	0.5	1.5	2.0 sawdust (—60m)	870	60.2	1.4	61.6	----------	Do.
30	3.8	0.3	1.9	1.0 sawdust (—60m)	870	100.0	trace	100.0	----------	Dark green, porous.
31	3.8	0.3	1.7	do.	870	91.2	0.1	91.3	----------	Do.
32	4.0	0.7	1.8	do.	880	79.0	7.9	86.9	----------	Not so porous, yellow scum on top.
33	4.0	0.3	1.9	0.2 ferric oxide	880	100.0	trace	100.0	----------	Porous, greenish brown.
34	4.0	0.3	1.9	0.4 ferric oxide	880	100.0	trace	100.0	----------	Do.
35	4.0	0.3	1.8	1.0 sawdust (—60m)	880	100.0	trace	100.0	----------	Do.
36	4.0	0.3	1.9	1.5 sawdust (—60m)	880	100.0	trace	100.0	----------	Very porous, greenish brown.
37	4.0	0.3	1.9	1.0 sawdust (—60m)	880	100.0	trace	100.0	----------	Porous, greenish brown.
38	4.0	0.3	1.9	0.5 sawdust (—60m)	880	100.0	trace	100.0	----------	Do.
39	4.0	0.3	1.9	None	880	100.0	trace	100.0	----------	Do.

TABLE 5.—*Effect on the roasting of concentrated Masinloc chromite of small quantities of lime, with varying quantities of soda ash and other reagents.*

[Concentrated chromite, 2 grams.]

[Exposure, 8.8 hours.]

Experiment.	Lime.	Soda ash.	Other reagents.	Averag temperature.	Recovery.			Remarks.
					Water soluble.	Hydrochloric acid soluble.	Total.	
	g.	*g.*	*g.*	°C.	*Per cent.*	*Per cent.*	*Per cent.*	
1	0.5	1.9	1.0 ipa (—20m)	880	93.2	0.2	93.4	Porous, dark green.
2	0.5	1.9	0.2 ipa (—20m)	880	51.3	5.8	57.1	Fused, yellow.
3	0.5	1.9	do	880	72.4	0.8	73.2	Do.
4	0.5	1.9	1.0 sawdust (—60m)	880	93.4	2.7	96.1	Porous, dark brown.
5	0.5	1.9	0.2 sawdust (—60m)	880	56.5	2.0	58.5	Fused, yellow.
6	0.5	2.1	1.0 ipa (—20m)	870	93.4	0.5	93.9	Porous, dark brown.
7	0.5	1.9	do	870	93.2	0.5	93.7	Do.
8	0.5	1.5	do	870	81.0	0.5	81.5	Porous, brown.
9	0.5	2.1	0.5 ipa (—20m)	870	72.6	2.8	75.4	Fused, yellow.
10	0.5	2.1	0.5 bagasse (—60m)	870	54.1	13.2	67.3	Do.
11	0.5	2.1	1.0 sawdust (—60m)	870	94.0	3.7	97.7	Do.
12	0.5	2.1	0.5 sawdust (—60m)	870	61.6	0.9	62.5	Do.
13	1.0	2.1	1.0 ipa (—20m)	870	45.2	0.6	45.8	Do.
14	0.5	1.9	1.5 sawdust (—60m)	870	93.2	3.4	96.6	Porous, dark brown.
15	0.5	1.9	1.0 sawdust (—60m)	870	95.2	2.2	97.4	Do.
16	0.5	1.9	0.5 sawdust (—60m)	870	85.8	3.5	89.3	Fused, yellow.
17	0.5	2.5	1.0 sawdust (—60m)	880	91.0	0.8	91.8	Do.
18	0.5	1.9	do	880	90.0	2.2	92.2	Do.
19	0.3	1.9	do	880	97.0	3.0	100.0	Porous, greenish.
20	1.0	2.5	do	880	75.5	4.6	80.1	Fused, greenish.
21	1.0	2.0	do	880	70.1	6.1	76.2	Do.
22	1.0	1.5	do	880	70.5	9.8	80.3	Do.

23	0.3	1.9	do	870	91.0	trace	91.0	Porous, dark green	c
24	0.3	1.7	do	870	87.0	0.9	87.9	Porous, brown.	
25	0.3	0.5	1.0 sawdust (—60m) +1.0 sodium sulphate	870	25.8	0.3	26.1	Porous, dark green.	
26	0.3	1.0	do	870	9.3	2.2	11.5	Porous, yellow.	
27	0	1.9	1.0 sawdust (—60m) +1.0 Sienna [b]	870	83.5	trace	83.5	Porous, brown.	
28	0	1.7	do	870	75.8	trace	75.8	Do.	

[a] $CaCO_3$.

[b] Laboratory Sienna.

[c] There was very little airing.

TABLE 3.—*Effect on the roasting of concentrated Masinloc chromite of varying lime and soda ash, other conditions remaining constant.*

[Concentrated chromite, 2 grams.]

Experiment.	Time.	Lime.	Soda ash.	Sawdust (—60m).	Average temperature.	Recovery.			Remarks.
						Water soluble.	Hydrochloric acid soluble.	Total.	
	Hours.	*g.*	*g.*	*g.*	*°C.*	*Per cent.*	*Per cent.*	*Per cent.*	
1	3.8	2.5	1.0	0.5	890	76.3	6.5	81.8	Fused, brown-yellow.
2	3.8	1.5	1.0	0.5	890	66.6	9.2	75.8	Fused, yellow.
3	3.8	0.5	1.0	0.5	890	48.4	10.3	58.7	Do.
4	3.8	0.3	1.0	0.5	890	52.6	3.8	56.4	Porous, dark brown.
5	3.8	0	1.0	0.5	890	44.7	trace	44.7	Do.
6	3.8	2.5	1.5	0.5	890	78.4	13.0	91.4	Fused, yellow.
7	3.8	1.5	1.5	0.5	890	60.7	18.7	79.4	Do.
8	3.8	0.5	1.5	0.5	890	61.5	10.3	71.8	Do.
9	3.8	0.3	1.5	0.5	890	74.4	4.2	78.6	Porous, brown.
10	3.8	0	1.5	0.5	890	66.4	trace	66.4	Do.
11	3.8	2.5	1.9	0.5	890	55.7	24.2	79.9	Porous, yellow.
12	3.8	1.5	1.9	0.5	890	66.5	21.0	87.9	Fused, yellow.
13	3.8	0.5	1.9	0.5	890	66.1	11.7	77.8	Do.
14	3.8	0.3	1.9	0.5	890	87.8	1.8	89.6	Porous, yellow.
15	3.8	0	1.9	0.5	890	80.7	trace	80.7	Porous, brown.
16	4.0	0.5	1.9	0.5	880	79.5	2.4	81.9	Fused, yellow.
17	4.0	0.4	1.9	0.5	880	76.0	4.0	80.0	Do.
18	4.0	0.3	1.9	0.5	880	88.5	5.9	94.4	Do.
19	4.0	0.2	1.9	0.5	880	95.9	1.7	97.6	Porous, dark brown.
20	4.0	0.1	1.9	0.5	880	93.0	trace	93.0	Do.
21	4.0	0	1.9	0.5	880	88.8	trace	88.8	Do.
22	4.0	0.3	1.9	1.0	880	93.5	2.1	95.6	Do.
23	4.0	0.3	1.9	1.5	880	95.0	0.6	95.6	Do.

24	4.0	0.3	1.9	0	880	72.3	2.7	75.0	Fused, yellow.
25	4.0	3.25	1.9	0.5	880	80.6	10.5	91.1	Porous, greenish yellow.
26	4.0	1.5	1.5	0.5	880	62.5	15.0	77.5	Fused, yellow.
27	4.0	0.5	1.5	0.5	880	66.0	3.9	69.9	Do.
28	4.0	0.3	1.5	0.5	880	72.3	8.2	80.5	Porous, dark brown.
29	4.0	0.15	1.5	0.5	880	76.8	0.6	77.4	Do.
30	4.0	0	1.5	0.5	880	72.0	trace	72.0	Porous, brown.
31	4.0	0.3	1.5	1.5	880	80.6	0.9	81.5	Porous, dark brown.
32	4.0	0.2	2.0	1.0	880	94.5	2.5	97.0	Porous, greenish.
33	4.0	0.2	1.9	1.0	880	97.3	0.9	98.2	Do.
34	4.0	0.2	1.8	1.0	880	96.7	1.1	97.8	Do.
35	4.0	0.2	1.7	1.0	880	91.3	0.9	92.2	Do.
36	4.0	0.2	1.9	0.5	880	93.5	3.5	97.0	Not so porous, greenish.
37	4.0	0.2	1.9	0	880	81.0	9.3	90.3	Least porous, greenish.
38	4.0	0.2	1.9	1.5	880	95.9	1.3	97.2	Very porous, greenish.
39	4.0	0.2	1.9	0.2	880	93.0	0.9	93.9	Not so porous, greenish brown.

show that with 25 per cent lime and 95 per cent soda ash, 93 per cent water recovery may be obtained with 50 per cent of ground rice hulls (—20 mesh); and 93 to 95 per cent recovery when 50 per cent sawdust is used (Experiments 4 and 15). No advantage is obtained by the use of 105 to 125 per cent of soda ash with the same amount of lime and rice hulls or sawdust (Experiments 6 and 17). Calcium carbonate apparently cannot take the place of lime (Experiment 13), and the addition of sodium sulphate to the roast mixture does not give good recovery (Experiments 25 and 26). "Sienna" prepared from the residue of a completely roasted ore seems to offer no advantage, probably due to the fact that no lime was added to the roasting mixture (Experiments 27 and 28). From Table 6 it appears that the best lime content is around 10 per cent (Experiment 19), and that more than 25 per cent sawdust is necessary for complete recovery of chromium (Experiment 23). This finding is verified by Experiments 33 and 38, where 50 per cent sawdust gives 97 per cent water recovery and 75 per cent sawdust gives 96 per cent recovery. It would also appear from experiment 34 that 90 per cent soda ash is sufficient for a 97 per cent extraction.

Before combining all the optimum conditions for the highest recovery of chromate, there still remains the study of the relative values of different reagents for diluting or other purposes. The substances tested were sawdust (—60 mesh), rice hulls (—20 mesh), bagasse (—60 mesh), flour, and iron oxide. Table 7 shows the effect of different quantities of these reagents on the recovery of chromate from roasting mixtures of concentrated chromite under optimum conditions of lime and soda ash. In these experiments the air supply was decreased. Rice hulls appear to be the best catalytic agent and give optimum recovery when used at 15 per cent. Sawdust and flour behave almost identically, yielding optimum recovery when used at about 50 per cent. Bagasse and iron oxides are the least effective diluting reagents, optimum recovery being obtained at 5 to 15 per cent concentration of these reagents.

We are now ready to determine water soluble recoveries with the optimum conditions of temperature 890° C., with sawdust clinkering agent constant, and with varying conditions of lime and soda ash. Table 8 gives the recoveries from unconcentrated ore and Table 9 gives those from concentrated ore. Text figs.

TABLE 7.—*Effect of catalytic agents on the roasting of concentrated Masinloc chromite, other conditions remaining constant.*

[Concentrated chromite, 2 grams; lime, 0.2 grams; soda ash, 1.9 grams.]

[Exposed 4 hours. Average temperature, 880°C.]

Experiment.	Other reagents.	Recovery water soluble.	Remarks.
	g.	*Per cent.*	
1	None.	85.8	Fused, dark green with yellow.
2	0.5 sawdust (—60m)	91.8	Not very porous, dark brown.
3	1.0 sawdust (—60m)	93.6	Porous, dark brown.
4	1.5 sawdust (—60m)	94.0	Do.
5	2.0 sawdust (—60m)	93.5	Do.
6	0.1 rice hulls (—20m)	92.6	Do.
7	0.3 rice hulls (—20m)	96.0	Do.
8	0.5 rice hulls (—20m)	93.5	Do.
9	1.0 rice hulls (—20m)	91.0	Porous, brown.
10	1.5 rice hulls (—20m)	87.0	Do.
11	2.0 rice hulls (—20m)	81.0	Do.
12	0.3 bagasse (—60m)	92.2	Slight fusion on bottom, brown.
13	0.5 bagasse (—60m)	91.3	Do.
14	1.0 bagasse (—60m)	90.9	Do.
15	1.5 bagasse (—60m)	91.3	Very porous, brown.
16	0.5 flour	91.0	Not very porous, dark brown.
17	1.0 flour	95.0	Slightly fused, dark brown.
18	1.5 flour	93.5	Porous, dark brown.
19	2.0 flour	91.5	Do.
20	0.1 ferric oxide	92.7	Slightly porous, dark brown.
21	0.2 ferric oxide	91.9	Porous, dark brown.
22	0.3 ferric oxide	89.6	Porous, brown.
23	1.5 ferric oxide	85.5	Do.

1 and 2 show the relation between water recovery and lime concentration for unconcentrated and concentrated ores respectively, and text figs. 3 and 4 show the relation between water recovery and soda ash concentration for the same samples.

From tables 8 and 9 and from text figs. 3 and 4 the poor results obtained in our preliminary experiments (Table 2) on the effect of varying soda ash in the fusion mixture can readily be understood. While the curves for both unconcentrated and concentrated ores are similar in character, a similarity which indicates that the ore actually possesses these characteristics, the curves for the different lime contents vary so greatly that at first glance they give the impression of error in manipulation or determination.

The case is different when the effect of varying lime content is studied (text figs. 1 and 2). Here the curves for different soda ash contents are similar in character, and they all point to the same maximum point of water recovery—0.45 to 0.50

TABLE 8.—*Effect of lime on the roasting of unconcentrated Masinloc chromite at different concentrations of soda ash and at the optimum concentration of sawdust.*

[Unconcentrated chromite, 2 grams; sawdust (— 60 m), 1 gram.]

[Exposure, 4 hours.]

Experiment.	Lime.	Soda ash.	Average temperature.	Recovery water soluble.	Remarks.
	g.	*g.*	°*C.*	*Per cent.*	
1	0	1.9	890	94.6	Porous, brownish green.
2	0.1	1.9	890	98.8	Do.
3	0.2	1.9	890	100.0	Do.
4	0.3	1.9	890	100.0	Do.
5	0.4	1.9	890	100.0	Porous, green.
6	0.5	1.9	890	100.0	Do.
7	0.7	1.9	890	81.1	Fused, yellow top.
8	1.0	1.9	890	79.8	Do.
9	1.5	1.9	890	72.2	Do.
10	2.5	1.9	890	53.7	Do.
11	3.5	1.9	890	59.0	Porous, yellow top.
12	0	1.8	890	91.4	Porous, brownish green.
13	0.2	1.8	890	98.0	Do.
14	0.4	1.8	890	100.0	Do.
15	0.5	1.8	890	100.0	Do.
16	0.7	1.8	890	91.8	Do.
17	1.0	1.8	890	77.0	Fused, yellow top.
18	1.5	1.8	890	72.6	Do.
19	2.5	1.8	890	62.0	Porous, yellow top.
20	3.5	1.8	890	66.5	Do.
21	0.45	1.7	890	96.5	Porous, brownish green.
22	0	1.6	900	80.8	Porous, brown.
23	0.1	1.6	900	81.1	Do.
24	0.2	1.6	900	86.8	Porous, brownish green.
25	0.3	1.6	900	90.0	Do.
26	0.4	1.6	900	90.8	Do.
27	0.5	1.6	900	91.1	Do.
28	0.7	1.6	900	85.5	Porous, yellow dots.
29	1.0	1.6	900	59.6	Fused, yellow top.
30	1.5	1.6	900	59.6	Do.
31	2.5	1.6	900	73.5	Porous, yellow top.
32	3.5	1.6	900	72.0	Do.
33	0	1.0	900	47.8	Porous, brownish green.
34	0.2	1.0	900	49.6	Do.
35	0.5	1.0	900	58.9	Porous, yellow dots.
36	0.7	1.0	900	65.0	Do.
37	1.0	1.0	900	73.0	Do.
38	2.0	1.0	900	70.6	Fused, yellow top.
39	3.5	1.0	900	69.2	Porous, yellow dots.
40	0	0.5	900	30.0	Porous, brownish green.
41	0.2	0.5	900	28.5	Do.
42	0.5	0.5	900	37.3	Porous, green.
43	1.0	0.5	900	40.6	Do.
44	3.5	0.5	900	42.7	Porous, green, white dots.
45	4.0	2.8	900	53.5	Fused, yellow.

TABLE 9.—*Effect of lime on the roasting of concentrated Masinloc chromite at different concentrations of soda ash and at the optimum concentration of sawdust.*

[Concentrated chromite, 2 grams; sawdust (—60 m), 1 gram.]

[Average temperature, 890°C.; exposure, 4 hours.]

Experiment.	Lime.	Soda ash.	Recovery, water soluble.	Remarks.
	g.	*g.*	*Per cent.*	
1	0	1.9	78.4	Porous, brown with yellow dots.
2	0.1	1.9	95.8	Porous, dark green.
3	0.2	1.9	98.7	Do.
4	0.3	1.9	94.4	Fairly porous, dark green.
5	0.4	1.9	82.0	Fused, yellow top.
6	0.5	1.9	77.9	Do.
7	0.7	1.9	81.3	Do.
8	1.0	1.9	80.2	Do.
9	1.5	1.9	71.4	Do.
10	2.5	1.9	73.4	Slightly porous, yellow top.
11	3.5	1.9	75.9	Do.
12	0	1.8	81.8	Porous, brown.
13	0.1	1.8	89.5	Do.
14	0.2	1.8	98.7	Porous, dark green.
15	0.3	1.8	86.1	Fused, yellow top.
16	0.4	1.8	68.5	Do.
17	0.5	1.8	76.6	Do.
18	0.7	1.8	82.1	Do.
19	1.0	1.8	71.8	Do.
20	1.5	1.8	78.0	Do.
21	2.5	1.8	86.7	Porous, brownish green.
22	3.5	1.8	86.7	Do.
23	0	1.6	76.8	Do.
24	0.1	1.6	90.5	Do.
25	0.2	1.6	90.5	Do.
26	0.3	1.6	88.6	Do.
27	0.4	1.6	70.0	Fused, yellow dots.
28	0.5	1.6	71.7	Do.
29	0.7	1.6	64 0	Do.
30	1.0	1.6	67.1	Do.
31	1.5	1.6	68.1	Do.
32	2.5	1.6	81.5	Porous, yellow dots.
33	3.5	1.6	84.2	Porous, brownish yellow.
34	0	1.0	47.5	Do.
35	0.2	1.0	55.4	Do.
36	0.5	1.0	59.3	Do.
37	0.7	1.0	66.8	Do.
38	1.0	1.0	70.0	Slightly fused, yellow top.
39	2.0	1.0	76.7	Porous, yellow top.
40	3.5	1.0	77.5	Porous, dark green.
41	0	0.5	34.0	Porous, brownish green
42	0.2	0.5	31.8	Do.
43	0.5	0.5	36.2	Do.
44	1.0	0.5	50.0	Do.
45	3.5	0.5	52.6	Do.

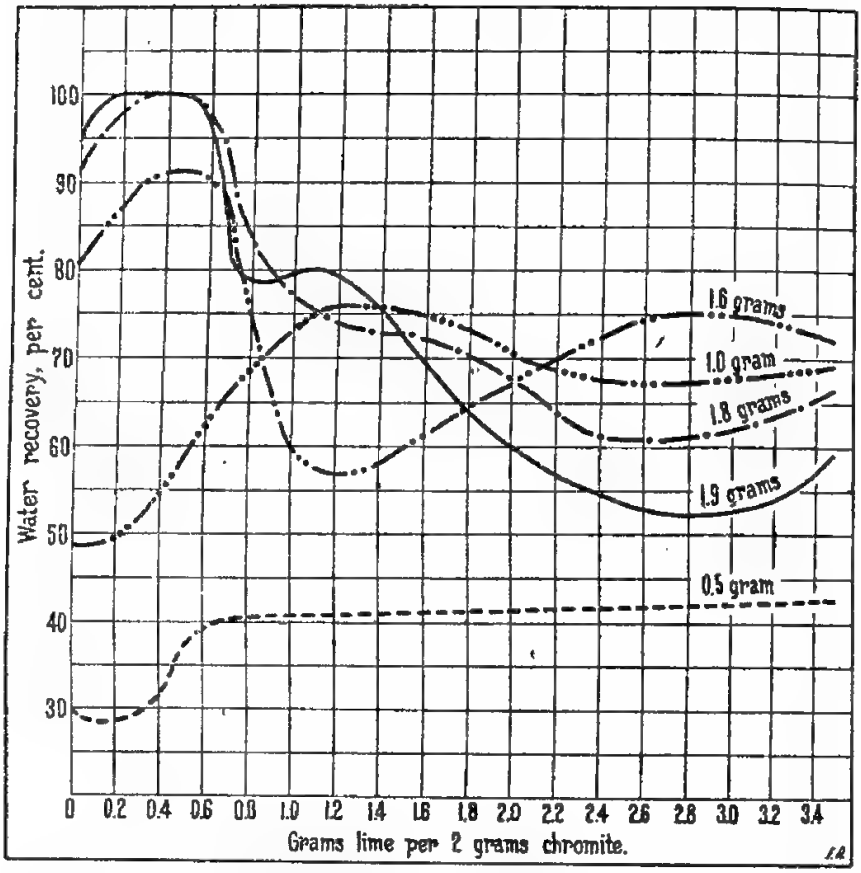

FIG. 1. Relation between quantity of lime used and water recovery from unconcentrated chromite with varying amounts of soda ash.

gram of lime per 2 grams of ore for the unconcentrated ore, and 0.15 to 0.20 gram of lime per 2 grams of ore for the concentrated ore, this maximum recovery being obtained only for mixtures containing more than 50 per cent soda ash, and minimum recovery for mixtures of 25 per cent soda ash or below. At no point up to 175 per cent lime is maximum recovery to be obtained except at the point already mentioned, and the failure of some workers to obtain a 100 per cent recovery by combining a great quantity of lime even with a great quantity of soda ash is now easy to understand.

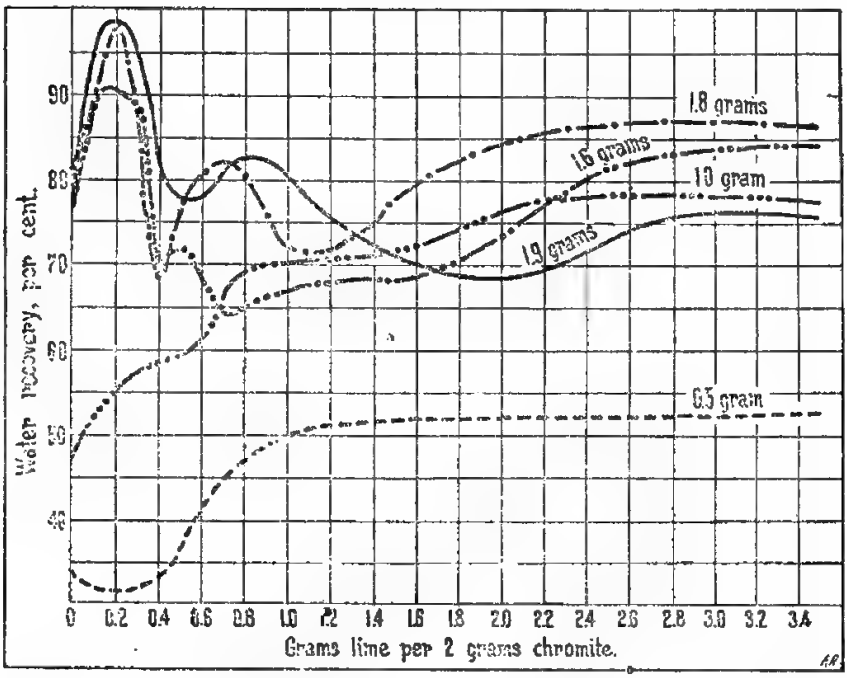

FIG. 2. Relation between quantity of lime used and water recovery from concentrated chromite with varying amounts of soda ash.

Moreover, among the chemical constituents of both unconcentrated and concentrated ores there is no ratio of the percentages of any constituent in the two samples that approximates 2 or 3, the ratio of the optimum limings for the unconcentrated over the concentrated sample, except that for silica. Or, to put it in another way, the ratios of the lime requirements to the silica contents are 4.5 for the unconcentrated ore and 5.5 for the concentrated ore, indicating that the effect of optimum liming is to take care of the silica of the ore, deficiency of liming resulting in part of the ore not being attacked, and excess in liming giving rise to complex calcium compounds of chromium which are not easily convertible into chromate. This finding is in agreement with Doerner's finding, in his experiments on the roasting of chromic oxide with sodium sulphate and lime, that silica is most detrimental to purity.

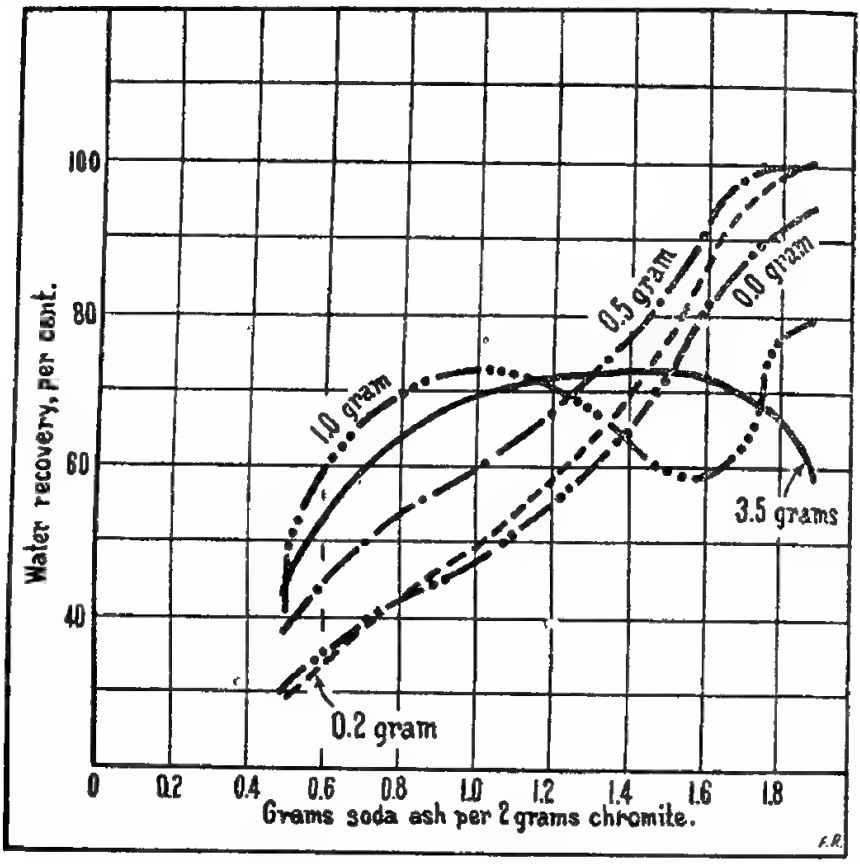

FIG. 8. Relation between quantity of soda ash used and water recovery from unconcentrated chromite with varying amounts of lime.

SUMMARY

For the efficient roasting of Masinloc chromite it has been shown that the percentages of lime, soda ash, and carbonaceous and diluting reagents are very important items to be considered. The optimum temperature of roasting is between 800 and 900° C. Of the carbonaceous substances, sawdust used at 50 per cent of the weight of chromite, or rice hulls used at 15 per cent of the weight of chromite, help to give the highest recovery of chromium as chromate. The optimum amount of soda ash (93.5 per cent purity) required for the highest recovery is between 85 and 90 per cent of the weight of the chromite, while the optimum amount of lime required is between 22 and 25 per cent for the unconcentrated chromite and around 10 per cent for the chromite concentrate. It is suggested that the

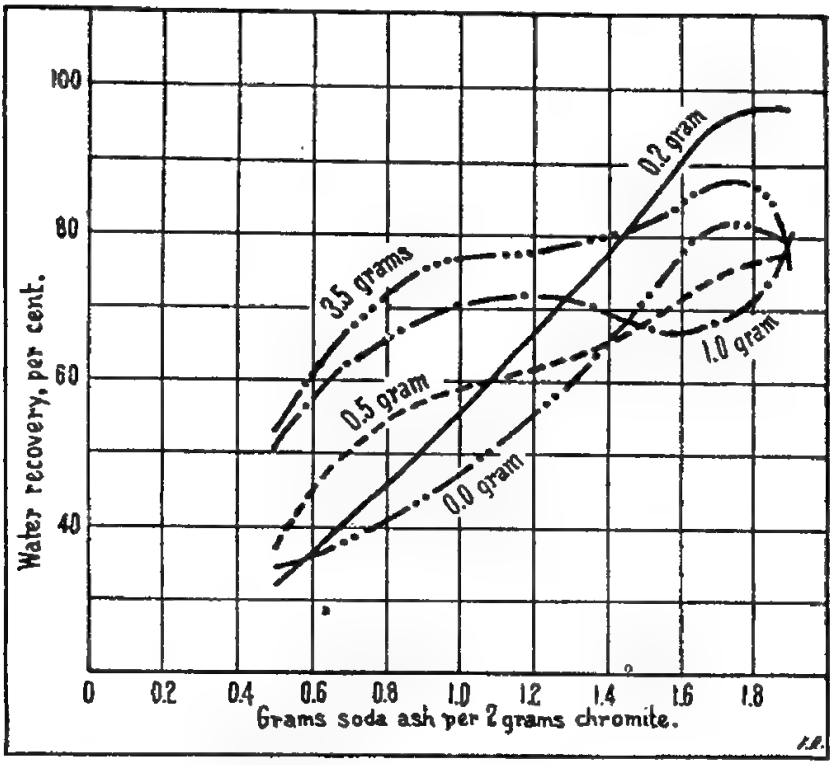

FIG. 4. Relation between the quantity of soda ash used and water recovery from concentrated chromite with varying amounts of lime.

exact lime requirements have something to do with the amount of silica in the chromite, about 5 times as much lime being required as there is silicia. A theoretical study of the effects of lime on the chromite constituents, together with an inquiry into the nature of chemical interaction among the chromite, soda ash, and lime on the one hand, and the catalytic carbonaceous or diluting agents on the other, would be highly interesting and fruitful.

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ILLUSTRATIONS

TEXT FIGURES

THE ILOKO ADJECTIVAL VOICE

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INTRODUCTION

I. VOICES IN ILOKO

There are two voices in Iloko, the substantival voice and the adjectival voice.

These two voices have been called, although very improperly, "active" and "passive." We have taken the liberty to give them new names, as has been explained before.[1]

Each of these two voices has its own special prefixes, infixes, and suffixes.

The Iloko have a propensity to a verbal construction, called "passive" by most grammarians, which we call substantival. Instead of saying: "I do this," they will say: "This is my doing." This construction, however, is far from general, and it is necessary to know when this substantival construction has to be used, and when the regular active construction, which we call adjectival, is required.

We shall first say a word about these two constructions in themselves, so as to explain them as clearly as possible, and then something about their use.

I. 1. The adjectival construction or voice is formed by putting the Iloko term which represents the English subject (and which we shall call the subject in the course of this grammar), in the nominative, and the Iloko term which represents the English object (and which we shall call the object in the course of this grammar), if there is any, in the oblique.

2. The substantival construction or voice is formed by putting the Iloko term that represents the English subject, or the subject, in the genitive, and the Iloko term that translates the English object, or the object, in the nominative. For instance:

1. In the sentence: "I take rice," "I" is the subject, and "rice" is the object. The construction of this sentence will be adjec-

[1] Iloko Substantives and Adjectives. App. Anthropos 26 (1931) 486–488.

tival in Iloko, and thus "I" will be in the nominative, and "rice" will be in the oblique.

Thus, in *Maŋ̃gálaak ití bagás, ak* is the abbreviated form of the personal pronoun in the nominative, and *ití bagás*, as may be seen by the article, is in the oblique.

2. In the sentence: "I take the rice," "I" is the subject, and "the rice" is the object. The construction of this sentence will be substantival in Iloko, and thus, "I" will be in the genitive and "the rice" will be in the nominative.

Thus in *Aláek ti bagás, k* (for *ko*) is the possessive pronoun, which, of course, represents the genitive, and *ti bagás*, as may be seen by the article, is in the nominative.

3. *a.* The place of each member of the sentence is the same in both voices: First, the verb; then, the subject; and finally, the object, thus: *maŋ̃gálaak ití bagás*, and *aláek ti bagás.*

NOTE 1. It may happen that the subject of the substantival voice is not a possessive, while its object is a personal pronoun; in this case the subject has to follow the verb immediately in the shape of a possessive of the 3d person, and the complete subject has to be repeated after the object.[2] Examples.

The boy laughs at me: *katawáannak ti ubíŋ̃.*
The old women whip us: *baútendakami dagiti bakét.*

b. When either the subject or the object has to be emphasized, it takes first place, and the other members of the sentence follow in the same order: First, the verb; then, the remaining term. In this case, the emphasized term is connected with the rest of the sentence by the ligature *ti.*[3]

siák ti maŋ̃gála ití bagás: it is I who take rice.
ti bagás ti aláek: the rice is what I take.

NOTE 2. Sometimes it may be convenient to have either the subject (in both voices), or the object (in the substantival voice), precede the sentence; but this can only be known through frequent practice. In this case, whenever the subject precedes, it has to be repeated in the sentence in the shape of either a personal pronoun (adjectival voice) or a possessive (substantival voice) of the 3d person.[4] Examples.

dagití bakét agbáutda ití ubíŋ̃:	the old women, they beat the child.
dagití bakét baútenda ti ubíŋ̃:	the old women, they beat the child.
ti ubíŋ̃ baúten dagiti bakét:	the child, the old women beat it.

II. A. As to the use of the two voices, it may be said in general that the adjectival construction is preferred whenever the stress is either on the action or on the one who does it, the

[2] To have and to be in Iloko. Philip. Journ. Sci. 66 (1938) 436.
[3] Ibid., p. 424.
[4] Ibid., p. 423.

subject, while the substantival construction is preferred whenever the stress is on the thing that has to be done, the object.

1. If the Iloko wants to say: I take rice, emphasizing the taking and leaving the term "rice" indeterminate, he will use the adjectival voice, thus:

mañgálaak ití bagás: I take rice (any rice).

2. If he wants to say: "I take rice," "I" and not somebody else, he will again use the adjectival voice:

siák ti mañgála ití bagás: it is I who take rice.

3. If he wants to say: "I take the rice," emphasizing "the rice" or making it entirely determinate, he will use the substantival voice:

ti bagás ti aláek: the rice is what I take.
aláek ti bagás: I take rice (not any kind of rice).

B. To explain more clearly what is meant by determinate and indeterminate:

1. If the Iloko wants to tell somebody to bring him rice, meaning any rice (indeterminate), in which case the action of taking is more important than the rice that has to be taken (the object), the stress being consequently on the action, he will use the adjectival voice and say:

mañgálaka ití bagás: take rice.

2. If he wants to tell somebody to bring him a certain kind of rice; that is, rice that has been spoken of before (determinate), in which case the rice that has to be taken (the object) is more important than the action of taking, the stress being consequently on the object, he will say:

aláem ti bagás: take the rice.

C. We may now draw the following rules, which are general, and without exceptions, and which cover the whole field of the Iloko verbal system:

1. The adjectival voice is used:

a. When there is no object (intransitive verbs); stress on the action. Examples:

uminúmak	I drink.
agtaráyka	you run.
nañgán	he ate.
makaáñgeskami	we can breathe.
makikúyogtayo	let us go with him.

pusáen ti tinápay	the bread is being eaten by the cat.
agpaágasta	we go to the doctor.
dumakkélkayo	you grow.
matúrogda	they sleep.
kimmagát ti áso	the dog bit.

b. When the object follows the verb and is more or less indeterminate; stress on the action. Examples:

uminúmak iti danúm	I drink water (any kind of water).
agbásaka iti líbro	read a book.
mañgarámidkami iti baláy	we make a house.
nakabírok iti bunéñg	he found a cutlass.
makisaóda ken Pédro	they talk with Peter.
agpataráytayo iti kabáyo	let us make the horses run.
sumakáyta iti báka	let us mount a cow.
nagisúratkayo iti inbagák	did you write down what I said?
umúli iti atépna	he climbs on its roof.
agsápul ni Juán iti pagiddaánna	John looks for a place for him to lie down.

c. When the subject precedes the verb; stress on the subject. Examples:

siák ti uminúm	it is I who drink.
siká ti mapán	you are the one who goes.
isú ti mayát	he is the one who is willing.
asíno ti agsáñgit	who weeps?
ti áso ti nañgála iti kárne	the dog is the one who took the meat.
awán ti nakabírok	nobody found it.
ti danúm ti nañgdadáel	the water spoiled it.
dakamí ti dimmakkél	we are those who grew.
dagiti napán idiáy Bontók ti namapátay iti púsa	those who went to Bontok were those who killed the cat.

2. The substantival voice is used:

a. When the object follows the verb and is determinate; stress on the object. Examples:

inuménk ti danúm	I drink the water (not any kind of water).
kaném daytá tinápay	eat that bread.
alàen ni Juán ti pirákna	John takes his money.
asinánmi ti kárne	we salt the meat.
sagádanda ti kuárto	they sweep the room.
ipányo ti ikán idiáy baláy	carry the fish into the house.
ibagáyo ti kayátyo	say what you like.
pagdigúsentayo ti nuáñg	let us bathe the carabao.
paarámidta ti lakása	let us have the trunk made.

b. When the object precedes the verb, stress on the object. Examples:

danúm ti inuménk	water is what I drink.
isú ti surótem	he is the one you follow.

otóñg ti ginátañgda	cowpeas are what they bought.
saán a daytóy ti kayátyo	this is not what you like.
asíno ti baútenna	whom does he whip?
ni Juán ti bináonta	John was the one we sent.
dagití púsa ti ayabántayo	the cats are what we call.
baláy ti bañgónenmi	a house is what we build.
bunéñg ti birókek	a cutlass is what I look for.
dakamí ti tulàdenyo	we are those you imitate.
awán ti nasapúlanna	he found nothing.

II. PREFIXES, INFIXES, AND SUFFIXES

Almost all simple prefixes, infixes, and suffixes allow combinations with other prefixes, infixes, and suffixes; we shall give the most important and characteristic ones under each simple prefix, infix, and suffix. Combinations of adjectival prefixes, infixes, and suffixes with substantival ones will be studied under the latter.

THE ILOKO ADJECTIVAL VOICE

1. THE PREFIX *AG*

a. THE SIMPLE PREFIX

I. Form of the present: the prefix *ag*. Form of the past: the prefix *nag*.

II. A. This is the most used of all prefixes, infixes, and suffixes for verbs used in the adjectival construction, and verbal stems that do not allow it are rather scarce. It is really the one almost universal prefix for intransitive verbs in the Iloko adjectival voice. Examples:

agsáñgitak	I weep.
nagsaóka	you spoke.
agsarita	he talks.
nagkatáwa dagití balásañg	the girls laughed.
agísem ti lakáy	the old man smiles.
nagsápulda ití tabáko	they looked for tobacco.
nagsúrat ni Ana	Ann wrote.
agtaráytayo ámin	let us all run.
agbásakayo	read.

B. This prefix is used especially:

1. With names of instruments, and forms a verb meaning: to use a certain instrument. Examples:

agdaklískami	we fish with a dragnet.
nagkatámda	they planed.
agragádi ni António	Anthony saws.
dakám ti agpandarás	we are those who cut with an adze.
nagságad	he used the broom.

asíno ti nagarádo	who plowed?
agbiolín ni Félix	Felix plays the violin.
nagsílaw dagití limmábas	those who passed carried a light.
agpaétda	they chisel.

2. With names of plays and games, and forms a verb meaning: to play a certain game. Examples:

agsúnayda	they spin tops.
nagsugál ni kabsátko	my brother gambled.
aglípay dagití ubbíñg	the children play at *lipay* (fruits used as marbles).
agkudókami	we play at *kudo* (pebbles used as jackstones).
nagtañggákayo	you played at pitchpenny.
dagitá ti nagsípa	those played at *sipa* (a kind of football).
agsintíkta	let us play at marbles (flipping).
nagkiñgkiñg da Juána	Joan and her companions played at hopscotch.

3. With names of clothing, ornaments, and forms a verb meaning: to wear a certain piece of clothing, and so on.

agbádoka	put on a coat.
nagsapín ni ádiñgko	my younger brother wore pants.
díka agkallogóñg	do not wear a hat.
isúda ti agsiñgsíñg	they are those who wear rings.
agulés ni gayyémko	my friend wears a blanket.
nagarítos dagití babbái	the women wore earrings.
agsagaysáyda	they wear combs.
ápay ñga agpáyoñgkayo	why do you carry an umbrella?

4. With names of fruits without owner—fish, and the like, and forms a verb meaning: to gather a certain kind of fruit, to catch a certain kind of fish, and so on.[5] Examples:

napánkami nagtabúñgaw	we went to gather bottle gourds.
íntayo agbisukól	let us go and gather pond snails.
agrasáda	they gather crabs.
agnatéñgta	let us gather vegetables.
nagkuritá da gayyémko	my friend and his companions gathered cuttles.
nagbayábaskami	we gathered guavas.
siák ti napán nagdaláyap	I went to gather lemons.
nagbílisda idí kalmán	they gathered sardines yesterday.

5. With names of ailments, and forms a verb meaning: to be affected by a certain kind of ailment. Examples:

agsakítak	I am ill.
aggurígur ni áma	my father has fever.

[5] Reduplication of Verbal Stems, II, 1, Note. Unpublished.

naggaddílkami ámin	we all had itch.
agsárut ti asáwana	his wife has consumption.
nagpúdotka itáy	you had fever a while ago.
aguyék	he coughs.
nagsíkada idiày	they had dysentery there.
nagburtóng idí ubíñg pay láeñg	he had smallpox when he was still a child.

6. With names of positions, occupations, trade, and so on, and forms a verb meaning: to have a certain position, to follow a certain profession and the like. Examples:

agsekretário ni ulitégko	my uncle has the position of secretary.
nagsoldádo dagití kaaróbak	my neighbors were soldiers.
agallawágida	they are carpenters by trade.
agokóm ti kaádalko	my classmate has the position of judge.
napán nagmédiko	he went to practise medicine.
agmáestra ni Isabél	Elizabeth is a teacher.

7. With stems usually formed into adjectives, or adjectival verbs in *ma*, and others, and forms a verb indicating the action corresponding to the state implied by the adjective, and so on. Examples:

agbulsék	he becomes blind.
agsiñgpétkayo	be virtuous.
nagánusda	they suffered it patiently.
agpílay ni Juán	John limps.
díka agbayág	do not be long.
agragsáktay ámin	let us all rejoice.
naginányadkami	we went slowly.
nagdarásta únay	we went very fast.
agsadút	he has a fit of laziness.
agpatáy ni gayyémko	my friend is dying.
dagití nagawán	those who died.

8. With numbers, and forms a verb meaning: to reach, for example, a certain number. In the past tense these verbs obviously mean: to be a certain number, because what became ten, twelve, and so on, also is ten, twelve, and so on. Examples:

aguppátda	they reach the number of four.
nagwalókami	we were eight.
agtalló púlo a tawén	he reaches his thirtieth year.
nagsiám a gasútda ñga immáy	they came nine hundred in number.
agduá a salúp	it amounts to two gantas.

b. COMBINATIONS

I. All these combinations form their past in the same way as the simple prefix *ag*, by changing *ag* into *nag:*

II. Nearly all forms of substantives, adjectives, numbers, and the like, allow the prefix *ag* to form intransitive verbs, with the same meanings as those explained under the simple prefix *ag*, especially II, B, 7 and 8. Examples:

nagkastóykami	we acted this way.
agpañgólo ti maysà	one takes the lead.
nagginasútda	they were (going) by hundreds.
nagsañgapúlokami	we were ten.
agmaúyoñg ni Francísco	Francis becomes insane.
nagpakinákemda iti dákes	they had bad intentions.
agdapoén daytá manók	that chicken becomes of a grayish color.
agtarikáyotayo	let us gather timber.
agkabannuág	he is at his full strength.
agbumaró	to become a young man.

III. Here follow some of the most noteworthy combinations:

A. Forms alluded to before; the prefix *ag* is used:

1. To form coördinate words and the plural of adjectives; these forms have been explained under the adjective.[6] Examples:

agkalúganda	they board the same car.
agkasinnalísal da Juán ken Antonio.	John and Anthony are rivals.
nagkapitlókami	we were third cousins.
agkalínasda	they pull the same string (they are of one mind).
dída agkaawátan	they do not understand each other.
agkainnawátanda	they understand each other.
dagití agkakadákes	the bad ones.
dagití agkakaíñgel a soldádo	the valiant soldiers.

2. With the combinations indicating reciprocity, rivalry, and so on. Examples:

naglinnímedda	they hid from one another.
nagpinnakawánda	they forgave one another.
agtinnúloñgtayo	let us help each other.
aglinnaíñgtayo	let us emulate one another in cleverness.
aginnápalda	they envy one another.
agkitankítada	they look at one another.
nagtuloñgtúloñgkami	we helped each other.
díkay agsusiksúsik	do not dispute with one another.
nagtuñgpatuñgpáta	we slapped one another in the face.
agkarinkarída	they make promises to one another.

[6] III. Special Forms, 1: coördinate words, IV; general remarks, II. Anthropos 26 (1931) 480–481, 485–486.

agkablankabláawda	they salute one another.
agtulidtúlid	it turns over and over.
aglinnukmeglukmégda a duá	both vie with one another in fatness.

3. With forms indicating resemblance, imitation, and so on. Examples:

agsinanpádi láeñg	he is only a fake (not a real priest).
nagsinansábuñg	it had the shape of a flower.
agsinanmayát ni José	Joseph acts as if he was willing.
agmarasiksíkan ti sáka ti baniás	the legs of the iguana are covered with scales.
agmarasinádag daytá sabá	that banana tree is leaning.
agmaragampáñg ni Catalína	Catherine is very frivolous.
agmarabettakán	it is nearly fissured.
agmaratamnáy	it tastes rather flat.
nagkaskastílakami	we acted like Spaniards.
agsañgsañgláytayo	let us imitate Chinamen.
naglallaláki ni Margaríta	Margaret wore men's clothes.

4. Sometimes with the prefix *si* including the notion of concomitance. Examples:

nagsiwará dagiti tattáo	the men scattered.
agsitáñgadkayo	look up.
agsiwarnák	he publishes the news.
agsiwáras	he distributes things.

5. With the suffix *an* in a very few cases; then the original meaning of the word in *ag* becomes stronger and more important. Examples:

agbelladán	he is overfed.
aglippiásan a panagyáman	an overflowing gratitude.
díkay agub-ubiñgán	do not act like children.
agkanibusánan ti biág	life is at an end.
agnakmánka	be full of prudence.

B. New forms:

1. The prefix *ag* is used with the prefix *tagi* to indicate property or possession.

agtagibunéñg ni apók	my grandfather carries a cutlass.
nagtagigayáñgda ámin	they all carried spears.
agtagipaltógtayo	let us carry a gun.
isú ti nagtagikuá	he was the owner.
agtagiláko	she sells (that is, a saleswoman).
nagtagipuráwda	they were clothed in white.
agtagibaláy	she looks after the house.
agtagianákka kaniák	consider me as your child.

2. The prefix *ag* is used with the prefix *in*, to form verbs meaning: to pretend to be so and so. Stems joined to the com-

plex prefix *agin* have their initial open syllable reduplicated, and, when they begin with a vowel, a glottal catch is placed between the complex prefix and the stem. Examples:

aginbubutéñg	he pretends to be afraid.
aginsasáñgit láeñg	he just pretends to weep.
patináyon ñga aginsasakít dagidiáy	those ones always pretend to be ill.
aginpipílay ta nasadút	he simulates lameness because he is lazy.
naginbubulsékkami	we simulated blindness.
bay-ám ta agintutúleñg láeñg	leave him because he only pretends to be deaf.
díka agbutéñg, aginbabáut láeñg	do not be afraid, he only pretends to whip.
aginbabannógkayo	you pretend to be tired.
aginbabaín	he simulates shame.
agindidiammó	he simulates ignorance.
nagin-aápalda	they pretended to be jealous.
agin-uuñgét	he simulates anger.
agin-aáwatda	they pretend to understand.
agin-iisú	he is presumptuous (literally: he pretends to be he).

NOTE 3. The complex prefix *agsin*, with the same modification of the stem and use of the glottal catch as noted with the preceding form, and the complex prefix *agsin . . . inn* indicate rivalry, reciprocity, and so on; but these forms have become almost antiquated. The same may be said about the combination *agsin . . . an*, meaning: to be mixed with, and so on. Examples:

agsintutúloñgda	they help one another.
agsinpipinnatigmáankami	we counsel one another.
agsinlalakián dagitá babbái	those women mix with men.

2. THE INFIX *UM*

I. Form of the present: the infix *um*. Form of the past: the infix *imm*.

II. A. This is a much used infix for verbs used with the adjectival construction, and, when used with stems that allow the prefix *ag*, it indicates an action of less duration, importance, or the like, than the latter. For example, *agtugáw*, to sit: *tumugáw*, to sit down; *agtakdér*, to stand; *tumakdér*, to stand up. Examples:

uminúm ti áso	the dog drinks.
umúlika	come up, come in.
immúlogkami	we went down, we left the house.
díka sumuñgbát	do not answer.
tumaráykayo	run.

napán immisbú	he went to make water.
tumakkí ti nuáñg	the carabao defecates.
lumúganta	let us climb in.
sumakáyda ití kabáyo	they mount horses.
gimmátañg ití bagás	she bought rice.
umísem	he smiles.
basáem ti sumaridát	read the following.
sumúrotka kaniák	follow me.
dumsáagkayo	alight.

B. This infix is used especially:

1. To translate the English: to grow (more), to become (more). Examples:

dumakkél ti ubíñg	the child grows.
lumakáy datáo	one ages.
bumassít ti bagàs	the rice diminishes.
umadú ti áso	the dogs increase.
immatiddág daytá	that grew longer.
umababá ketdí	it rather grows shorter.
immátap ti nuáñg	the carabao became wild.
umámo ti bákes	the monkey gets tame.
lumamíis ti danúm	the water cools down.
sumayáat	it becomes better.

2. To form verbs which indicate the threatening of an action rather than the action itself. In English when one says: that dog bites, it does not necessarily mean that he is actually biting. The Iloko have two different ways to render both meanings: *agkagát*, he actually bites; *kumagát*, he threatens biting. Examples:

bumáut daytá lakáy	that old man threatens whipping one.
tumúdo	it threatens rain.
kumagát ti ásoyo	your dog bites.
sumipát ta bakét	that old woman threatens slapping one.
bumugták ni Juán	John threatens scolding.
kumábil	he threatens beating one.
lumabúga daytá	that one turns red.

NOTE 4. A similar notion is included in a few adjectives or substantives, formed with the infix *imm:* they indicate resemblance with what the stem implies. Example:

simminublán	something resembling a sinublán pot.

3. THE PREFIX *MAKA*

I. Form of the present: the prefix *maka*. Form of the past: the prefix *naka*.

II. This prefix is used:

1. To indicate active possibility, and, when used with the form of the past, to indicate completion of the action. Examples:

makaúliak	I can climb up.
saànak a makataráy	I cannot run.
makasañgpétkayonto	will you be able to come home?
díak makapagná	I cannot walk.
dída makakutí iti butéñg	they cannot move through fear.
idí ubíñgak nakataráyak	when I was a child I could run.
saán pay a nakapagná idí kalman	he could not yet walk yesterday.
nakadánon idiáy Alílem	he arrived at Alilem.
nakapánen	he went already.
nakarubbuátkami	we finished our preparations for the journey.
nakadáit	she finished sewing.
nakainúmka	did you drink?

2. To indicate natural needs. Examples:

makatúrog ni Juán	John is sleepy.
nakainúmak únay	I was very thirsty.
rimmuár ta makaisbú	he went out as he wants to make water.
makatakki daytá áso	that dog wants to defecate.
makatabákoda	they want a smoke.
makakatáwa ni Ana	Ann feels like laughing.
makasáñgit ti ubíñg	the child feels like weeping.

3. To indicate ordinary effect; in this case the initial open syllable of the stem is sometimes reduplicated. Examples:

ti básol a makapatáy	the grievous sin (literally: the sin that kills).
makaágas daytá a róot	that herb has curative power.
díka agtàkaw aniá la ketdí ta makabásolka	do not steal lest you commit a fault.
nakatipéd daydiáy	that one was an impediment.
makaúma	it is tiring.
makasúya ti tabá	fat causes nausea.
makatutúdo	it causes rain.
makasasadút daydiáy	that makes one lazy.

4. With cardinal numbers, to indicate how many of a certain class one wants to buy, one takes, how many of a certain class something can contain, and so on. With the numbers in *kanika*, the prefix simply becomes *makanika*.[7] Examples:

makatallóak	I want to buy three.
nakapitókami	we took seven.
makaduá daytá karretón	that cart holds two.
nakalimá kanó	it is said to have been able to hold five.
makanikaduá púloda ket duá	they want to take twelve.

[7] The adverb, II; adverbs of time, III. Unpublished.

III. The prefix *makapag* (past: *nakapag*) : This prefix is used with stems that allow the prefix *ag* to indicate that the action implied by the stem is or is not impeded by an obstacle from without (physical inability). For examples, *díak makasúrat*, I cannot write (because I did not go to school, or for some similar reason) ; *díak makapagsúrat*, I cannot write (because I have no pen, people push me, my arm is broken, or for some similar reason). Examples:

saánda a makapagálad	they cannot make a fence.
díkam nakapagtugáw	we could not sit down.
díak nakapagtúloñg	I could not help.
saánkam a makapagkatáwa	we cannot laugh.
makapagtaráykayo ditóy	can you run here?
saánkayo a makapagsúrat ta agginginéd	you cannot write because there is an earthquake.
saánkami a nakapagsaríta ta adú ti ubbíñg	we could not talk as there were many children.

NOTE 5. *a*. The combination *makapag . . . inn* (past: *nakapag . . . inn*) of reciprocity, and the complex prefix *makapagin* (past: *nakapagin*) of pretending, both derived from the preceding, are rarely used. Examples:

saánda a nakapagkikinnáta	they were not able to see each other.
díak makapaginpipílay	I cannot pretend to be lame.

b. The prefix *makapañg* (past: *nakapañg*) differs from *makapag* in the same way as the transitive prefix *mañg* differs from the intransitive prefix *ag*. Examples:

makapamárut daytá manók	that chicken sheds its feathers.
nakapañgdúsa kaniàk	he could punish me.

4. THE PREFIX *MAKI*

a. THE SIMPLE PREFIX

I. Form of the present: the prefix *maki*. Form of the past: the prefix *naki*.

II. This prefix is used:

1. To indicate that something is done with others. Examples:

makisaríttakam kenkuána	we talk with him.
napánda nakisugál	they went to gamble.
íntayo makibúya	let us go and see (the performance).
makikúyogka	go with (him).
nakipán ni Luis	Lewis also went.
madída a makitúlag	they do not want to make a contract.
nakiasáwa ni Ana	Ann married.
ínta makiáni	let us go to participate in the harvest.
kayátko ti makisaó	I want to talk with (you).
makilásinka itì daytóy	keep away from this one.
napán nakigubát	he went to war.

NOTE 6. Note the difference between the two expressions:

agápa da Juán ken António	John and Anthony quarrel.
makiápa ni Juán ken António	John quarrels with Anthony.

2. To indicate that somebody treats a person as his father, friend, or the like, according to the meaning of the stem. Examples:

makiádi kaniák	he treats me as his younger brother.
makiamákami kenkuána	we treat him as our father.
makigayyémda ken Juán	they make friends with John.

3. With stems meaning "to ask," without changing the latter's meaning. Examples:

makidáwatka ití àrak	ask for wine.
nakidáwatda iti kuárta	they asked for money.
nakirañgkápda iti suñgród	they asked for fuel.
makirañgkápkami ití natéñg	we ask for vegetables.
ínka makisaludsúd	go and ask.
makiintúodak	I ask.

4. With names of fruits, and the like, and forms a verb meaning: to ask for a certain kind of fruit, and so on. Examples:

makinatéñgka	ask for vegetables.
makibayábastayo ken Juán	let us ask John for guavas.
nakitabákcak ken' áma	I asked my father for tobacco.
ínkayo makisidá	go and ask for viands.

b. COMBINATIONS

I. All these combinations form their past in the same way as the simple prefix *maki*, by changing *maki* into *naki*.

II. The prefix *maki* is used:

1. With the prefix *ka* and with the combination *ka . . . an*, indicating companionship. Examples:

makikatugáwak kenká	I sit down with you.
makikabbaláykami ken Juán	we live in the same house with John.
nakikaiddá kaniák	he lay down with me.
makikadáratayo kenkuána	we are of the same blood as he.
makikabagiánda kaniák	they are relatives of mine.

2. With the combinations indicating reciprocity, rivalry, and so forth. Examples:

makisinnakláñg ken amána	he faces his father.
makisinnúratda ití gayyémda	they write to their friend and vice versa.
nakitinnúlagda	they made a contract.
makiinníliw	he longs to see (him) and vice versa.

makilinniñgáy kaniák	he gives me some distraction and vice versa.
makibinnílañgda kenkuána	they count it over with him.
makibalanbalákad	he gives good advice and receives it.
makiammoammó	he becomes an acquaintance.
makitapkitapkíl kadagití babbái	he mixes with women.
makipinnatenpatégak kadakayó	I prize you very much and vice versa.

3. With the infix *um*, and forms a verb meaning: to desire, to have a longing for what is expressed in the stem. Examples:

makisumarítaak	I want to talk.
makikumitada ití balàyko	they want to see my house.
makiuminúmkami	we want to drink.
makidumámag	she wants to ask for information.

III. The prefix *makipag* (past: *nakipag*): This prefix is used with stems that allow the prefix *ag* to indicate that the action implied by the stem is performed in the company of somebody who himself performs it in the company of others. For example: *kayátko ti makisaó kenkuána*, I want to have a talk with him; *ínnak makipagsaó*, I shall go with (you) to have a talk with (him); *bay-ám ta makisaríta kaniák*, let him be, so that he may have a talk with me; *adú ti makipagsaríta*, many people join (him) to have a talk with (you). Examples:

mokipagtáwidda kaniák	they are my coheirs.
nakipagmaymaysá kadakamí	he was one with us.
makipagpúyatkay kaniák	watch with me.
nakipagtúlag kadakuáda	he arranged the contract with them.
nakipagbiág kadatayó	he lived with us.
idí napának nakimísa nakítak a nakipagmísa ni apó Antonio	when I went to hear Mass, I saw Father Anthony saying Mass also.

NOTE 7. *a.* The combination *makipag . . . inn* (past: *nakipag . . . inn*) of reciprocity, and the complex prefix *makipagin* (past: *nakipagin*) of pretending, both derived from the preceding, and the complex prefixes *makisin* and *makisin . . . inn* of reciprocity are rarely used. Examples:

nakipagtitinnúloñgkayo	join them in helping one another.
nakipagintutúleñg	he also pretended to be deaf.
makisinpapatigmáankami	we counsel one another.

b. The prefix *makipañg* (past: *nakipañg* differs from *makipag* in the same way as the transitive prefix *mañg* differs from the intransitive prefix *ag*. Examples:

íntayo makipamonpón	let us go to the funeral.
dagití makipañgúyog	the companions.
nakipañgrabíi	he had supper with them.
napán nakipañgán kenkuána	he went to eat with him.
nakipañgdalús kadagitá	he helped cleaning those.

5. THE PREFIX *MAÑG*

I. Form of the present: the prefix *mañg*. Form of the past: the prefix *nañg*.[8]

II. A. This prefix is used chiefly to change into the adjectival construction a great number of verbs, which are ordinarily construed substantivally and which, for one of the reasons explained above, have to become adjectival. Most of the prefixes of the substantival verbs are combined with the prefix *mañg*, whenever the construction has to be changed into the adjectival voice; therefore we shall give explanations and examples of the use of this particular prefix later on.

B. The prefix *mañg* is used especially:

1. With names of fruits without owner, fish, and the like, and forms a verb meaning: to gather a certain kind of fruit, to catch a certain kind of fish and so on.[9] Examples:

íntayo mañgáyo	let us go and gather wood.
napánda nañgróot	they went to get grass.
umáykami mañglánot	we come to get vines.
nanuñgródda	they gathered fuel.
ínka mañgípon	go and catch *ipon* (a kind of very small fish).

2. To form verbs meaning: to buy something in general. Examples:

íntayo mañgnuáñg	let us go and buy carabaos.
umáyda mañgápas	they come to buy cotton.
namàka ti kayátda	buying cows is what they want.
napánda nañgmanók	they went to buy chickens.
ínta mamágay	let us go and buy rice.

3. With words indicating the worth of something in money, and forms a verb meaning: to be worth each a certain amount. Examples:

manalapí	they are worth fifty centavos each.
mamísos daytá	that is worth a peso.
manikápat	they are worth twelve centavos each.

4. In some other cases. Examples:

mañgán ni Juán	John eats.
mamigátkami	we breakfast.
nañgaldáwkayon	have you had lunch?
ínkayo mañgrabíi	go and take your supper.

[8] Notes on Iloko. Anthropos 23 (1928) 1037, 1038.
[9] Reduplication of Verbal Stems. II: 1, Note. Unpublished.

6. THE PREFIX *MA*

a. THE SIMPLE PREFIX

I. Form of the present: the prefix *ma*. Form of the past: the prefix *na*.

II. A. This prefix is used chiefly for the passive voice, and practically every prefix and suffix of the Iloko substantival voice may be combined with it; therefore we shall give explanations and examples of the use of this particular prefix later on.[10]

B. The prefix *ma* is used also:

1. To indicate passive possibility (with the form of the present). Examples:

makíta ti baláy	the house can be seen.
saán a madáit	it cannot be sewn.
matarimáan pay	can it still be repaired?
saán a matilíw ti kabáyo	the horse cannot be caught.
saán a maibús daytá	that cannot be used up.
maála	can it be taken?
saán a maúray	it cannot be waited for.
di matúkod	it cannot be fathomed.

2. In some other cases. Examples:

madíkami	we won't.
natúrogda	they slept.
mabalín	it is possible.
masápul	it is necessary.
masakít ti anàkko	my child is ill.
nabisínkayo	were you hungry?
nawáwkami	we were thirsty.
masdáawda	they are astonished.
naúma dagití gayyémko	my friends got tired of it.
nabátida idiáy ílida	they remained in their town.
masúya ni Santiágo	James nauseates.
maariékkami	we sicken at it.
mapúrarda	they are dazzled.
awán ti nabáti	nothing remained.

b. COMBINATIONS

1. The complex prefix *masi* or *masin* (past: *nasi* or *nasin*) has the notion of concomitance combined with the original meaning of the prefix *ma*. Examples:

masidadáankami or *masindadáankami*	we are waiting obsequiously, we are ready.
masitammél daytá ubíñg	that child is struck dumb.

[10] The Substantival Prefix *ma*. Unpublished.

2. When the suffix *an* is joined to a verb in *ma* this combination (past: *na . . . an*) very often indicates either a completion, an intensification of what the verb with the simple prefix *ma* would indicate, or the impossibility of performing it. Here also the suffix *an* retains its distinctive quality: it is a real locative, as may be clearly seen by some of the examples, for example: *init*, sun, *mainitan*, it lies in the sun; *napúdot*, it is warm, *napudótan*, it is full of heat; *mapúkaw*, it is lost, *mapukáwan*, he loses something. More will be said about this combination later on.

It should be remembered, however, that the suffix *an* of substantival verbs may be used together with the adjectival prefix *ma*, in which case the explanation of this construction will be found later on, as has been stated above. Examples:

narabiiánkami	we were overtaken by the night.
napudótan idiáy	it got thoroughly heated there.
mabisinán	he starves.
saán a masapúlan	it cannot be found.
mainítanto idiáy	it will lie in the sun there.
napukáwan ni Juán	John lost something.
napuyátan dagití ubbíñg	the children were awake too long.
nalam-ekán	he got thoroughly cold.
nasimataànak láeñg kenkuána	I only saw him with a glimpse.

3. When the prefix *ag* is joined to a verb which retains its own prefix *ma*, the first consonant of the latter is changed into *k*, and the complex prefix *agka* (past: *nagka*) gives the verb something of an active meaning; for example; *maañgínan*, it is exposed to the wind, *agkaañgínan*, he exposes himself to the wind. Examples:

ápay a napánka agkapudótan	why did you go to become entirely hot.
nagkaañgínanda	they exposed themselves to the wind.
agkainítan ni António	Anthony (lies) in the sun.
agkapitákan	he gets himself covered with mud.
agkarugitán	he dirties himself.
agkatudoán	he (stands) in the rain.
agkalimdoósan	he gets himself covered with cold sweat.
agkadinámag ti pintásna	her beauty is renowned wide and far.

7. THE PREFIX *KARA*

I. This prefix has no special form for the past.

II. The prefix *kara* is used to indicate that the action implied by the stem is repeated frequently. Examples:

karaáwid ti gayyémko	my friend goes home continually.
karaumáy	he comes all the time.

III. The prefix *kara* may be combined with the prefix *ag* (past: *nagkara*) and with the infix *um* (past: *kimmara*), and the difference between the two is the same as that between *ag* and *um*.

agkarasublí ti lúgan	the cart comes back continually.
agkarabóoñg daytá piñggán	that plate gets cracks all the time.
agkaraáwid	he goes home continually.
agkaraumáy	he comes all the time.
nagkarapugsát ti talí	the rope snapped all the time.
kumarasublí	it comes back continually.

8. THE INFIX *AN*

I. This infix, in the adjectival voice, occurs only in combinations either with the prefixes *ag, agka,* or *ma,* or with the infix *um;* the form of the past of the original prefix or infix is retained in these combinations.

II. The infix *an* is used to form verbs indicating repetition, intensity, and so on, of actions, especially of sounds.

When the infix *an* is used with the complex prefix *agka,* the action or sound indicated by the word is produced by more individuals, for example, than when it is used with the simple prefix *ag;* the second prefix *ka* stands either for companionship or plurality.

When the infix *an* is used with the infix *um,* the action or sound indicated by the word is of shorter duration and more often repeated than when it is used with the prefix *ag.*

The prefix *ag* and the infix *um* have an active meaning, the prefix *ma* has a passive one. Examples:

agsanultíp	he blows a whistle with force.
agbanítog	he thumps.
agranetrét ti rikép	the door creaks.
agkanuskús	he gathers to himself.
nagbanetbét	he struck with force.
agkabanetbétda	they strike with force.
bumanorbór ti karayán	the river roars.
dumanasádas	it rustles.
kimmanagkág ti pandilíñgna	her skirt rustled.
tumanogtóg	he knocks repeatedly.
bumanerbér ti áñgin	the wind roars.
bumanítog	he thumps repeatedly.
wumaneswés	he whirs along.
sumanigkí	he sits up with a sudden jerk and sighing.
kumanagkág ti sellág	the moon shines bright.
nakanagkág ti sellág	the moonlight was very beautiful.

NOTE 8. Very common forms, more or less onomatopoetic, and chiefly used for verbs indicating repetition or intensity of sound, have been explained in Notes on Iloko.[11]

The difference of the complex prefix *agka* and that of the simple prefix *ag* consists here also in the notion of plurality, which is included in the prefix *ka;* this notion of plurality bears on the cause or origin of the action or sound.

The infix *um* here also indicates a slighter action or sound than the prefix *ag.*

The prefix *ag* and the infix *um* have an active meaning, while the prefix *ma* has a passive one.

a. The forms with repetition of the initial consonant. Examples:

agbabtóog	he thumps.
nagkaktóol	he knocked noisily.
nagkababtóogda	they thumped.
agkakaktóol dagiti ubbiñg	the children knock noisily.
agkakakliiñgda	they jingle.
agkararpáakda	they bang.
nababtóog ti niúg	the coconut thumped.
makaktóol	it knocks noisily.
makakliiñg	it clinks.

b. The forms in *n*, where the infix *an* remains distinctly apparent: *agkana, mana.* Examples:

agkanabtóogda	they thump.
nagkanaktóol dagiti sapátosna	his shoes knocked noisily.
agkanakliiñgda	they jingle.
agkanalplitda	they clap.
agkanakláañgda	they clang.
agkanaltóogda	they crepitate.
nanabtóog ti niúg	the coconut thumped.
manaktóol	it knocks noisily.
manakliiñg	it clinks.
manaltóog	it crackles.
manalsíit	it spits.

c. The forms without repetition of the initial consonant. Examples:

agrittóok	it cracks.
nagrittíik	it cracked.
agrottóok	it cracks.
lumtáak	it clacks.
lumtóog	it cracks.
limsíit	it spat.

9. THE PREFIX *AGA*

I. This prefix has no special form for the past.

II. This prefix is used:

[11] Anthropos 23 (1928) 1039, 1040.

1. With stems meaning a part of the body, or the like, to indicate how far the water, a piece of clothing, or the like, reaches. Examples:

agasíket ti karayán	the water of the river reaches the waist.
agatúmeñg idí kalmán	it reached the knees yesterday.
agasíko dagiti mángos ti bádok	the sleeves of my coat reach my elbow.

NOTE 9. Sometimes the prefix *paga* is used with the same meaning. Example:

pagateñgñgéd ti danúm	the water reaches the neck.

2. With stems meaning a substance which diffuses a certain odor, to characterize the smell of something. Examples:

agabáwañg ti ñgíwatmo	your mouth smells of garlic.
agaárakkayo	you smell of wine.
agalasoná ditóy	it smells of onions here.

10. THE SUFFIX *EN*

I. Form of the present: the suffix *en*. Form of the past: the infix *in*.

II. This suffix is used:

1. With stems indicating ailments, and the like, and forms a verb meaning: to feel the symptoms of a certain disease, for example. Examples:

gaddilén ti ubíñgko	my child gets itch.
burtóñgenak	I am getting the smallpox.
talimudáwen ni Juán	John is dizzy.
patináyon a rabii alimbaságenak	every night I have the nightmare.
til-lén ti ubíñg	the child has hiccups.
saguyepyepénkami	we are overcome by sleep.
tinarobáayka itáy bigát	you were weak this morning for not having eaten last night.
talipuñgáwenak ditóy balày	I feel sad all alone in this house.
alimutñgénkayo	are you angry?
sakitén ti ólok	my head aches.
sakitén ti nákemko	I am sorry.

2. With names of parts of the body, or the like, and forms a verb meaning: this or that part of the body, aches, is sore, for example. Examples:

bakráñgen ti anákko	my child has pain in its side.
karabukobénda ámin	all of them have a sore throat.
sikétenak	I feel pain in my waist.
basisáwen ni Juán (from *basísaw*, bladder)	the water gurgles in John's belly (for having drunk too much of it).
rurusókenda (from *rúsok*, stomach)	they eructate.

3. With names of animals, or the like, to indicate that a certain animal has started eating, consuming, for example, something. Examples:

ináso ti kárne	the dog got at the meat.
kotonén ti inapúy	the rice is full of ants.
inánay ti lúpotko	my clothes were ruined by white ants.
pusáen ti tinápay	the cat is eating the bread.
dináñgaw ti págay	the rice has been devastated by stink-bugs.
binokbók ti bagás	the rice is full of rice weevils.
ayaménak	my skin is irritated by chicken ticks.
kimatén ti káyo	the tree is struck by lightning.

4. To form verbs which indicate that the subject in question has the quality of what the stem implies. In this case the first open syllable of the stem is reduplicated. Examples:

babadoén daytá lúpot	that cloth is good for coats.
guguyóden ti nuáñña	his carabao is good for drawing purposes.
aadigién toy kàyo	this timber is good for posts.
sasapatósen di lálat	that leather is good for shoes.
gagabúten	yard grass, *Eleusine indica* (literally, easily grubbed up, or: which has to be grubbed up).
dadanúgen	a variety of banana (from *dánug:* cuffing).
arámid a dinederrép	an act of concupiscence.
sinasarírit	it is full of wit.
iniilóko daytá súrat	that letter is written in Iloko.
kinakararuá	coming from the soul.
ti íma a linalaság	the arm of flesh.
binabái daytá	that one is like a female.

11. THE SUFFIX *AN*

I. Form of the present: the suffix *an*. Form of the past: the infix *in* and the suffix *an*.

II. This suffix is added to cardinal numbers and to the interrogative *manó*, to ask or indicate how many of a certain class one obtains. It is of very little use. Examples:

manoánka	how many do you get?
limaának a taróñg	I get five eggplants.
inínnemán	he got six.

NOTE 10. This suffix has sometimes the same meaning as the adjectival suffix *en*, under II, 4. Example:

arámid ñga inuubiñgán	a childish act.

12. COMBINATIONS WITH *TARI*, AND THE LIKE

I. These combinations have no special form for the past.

II. The prefixes *tari*, *tagi*, and *ari* or *arin* may be combined with the suffixes *an* and *en*, to indicate that the subject is very near or on the point of undergoing what the stem implies. Examples:

taribaútanak kenká	I am going to whip you.
turianakán ni bakétko	my wife is near childbirth.
tagiloomán ti sabá	the bananas are nearly ripe.
ar-aripatayának	I am at the point of death.
ar-aribetbetànak	I was just going to strike.
ar-arimadiánka	you were going to refuse.
arinbabaútanka láeñg kaniák	you are always ready to whip me.
ar-arinpatayán	he is at the point of death.
arinturógen	he seems to be asleep.
arintutudoén	it is about to rain.

13. FREQUENTATIVE PREFIXES

I. These prefixes have no special form for the past.

II. The most important prefixes of the adjectival voice have a special form of frequentative which indicates a repetition, a successive performance, or an intensification of the action implied by the ordinary form of the verb.

When the simple prefix allows this frequentative form, so do also generally the complex prefixes derived from that simple prefix; so, for example, if the simple prefix *ag*, which allows this frequentative form (*manag*), is combined with other prefixes into *agin*, *agkara*, for example, the latter also allow the frequentative form of *ag* (*managin*, *managkara*, and others [12]).

The frequentative form derived from:

1. *Ag* is *manag*. Examples:

managsaludsúd ni Pedro	Peter always asks questions.
managsarítaka	you are quite a talker.
managsaóda	they speak very much.
managinúm ni Cristóbal	Christopher is a drinker.
managbarték	he is a drunkard.
dagiti managdáit	the seamstresses.
dagiti managatép	the roofers.
managsáñgit dagitóy ñga ubbíñg	these children always weep.
managkatáwakayo la únay	you laugh to excess.
managisem ni António	Anthony always smiles.

[12] Notes on Iloko. Anthropos 23 (1928) 1037, 1038.

managságad ti anákko	my daughter has always the broom in hand.
managkiñgkíñgda	they always play hopscotch.
managulés ni daydiáy	that one always wears a blanket.
managpáyoñg da Artúro	Arthur and his companion always carry an umbrella.
managbayábasda ñga agkabsát	she and her sister always gather guavas.
managsakít ni íkitko	my aunt is always ill.
managgurígurkami	we always have fever.
managuyék ni Simón	Simon always coughs.
managánuska a táo	you are a very patient man.
managkastáta	let us always act that way.
managpakinákemda iti saán a rumbéñg	they always meditate what should not be.
managinnápalda	they always envy each other.
managsusiksúsik da Juán	John and his companions always dispute.
managtinnuloñgtúloñgda	they always help one another.
managsinanmadí ni gayyémko	my friend always acts as if he refuses.
managsitàñgadkayo	you always look up.
managtagibunéñg ni áma	my father always carries a cutlass.
managtagiláko ni Catalína	Catherine is always selling things.
siká ti managinpipílay	you are the one who always simulates lameness.
managintutúleñg dagiti adálanna	his students always simulate deafness.
managin-iisú daytá babái	that woman is very presumptuous.

2. *Maka* is *mannaka*. Examples:

mannakabalín ámin ti Diós	God is almighty.
mannakabírok ni ína iti mapúkawko	my mother always finds what I lose.
mannakainúm daytá báka	that cow always wants to drink.
mannakatúrog ti asáwak	my wife is always sleepy.
mannakatipéd	it is always in the way.

3. *Maki* is *mannaki*. Examples:

mannakiriñggórka	you are always quarreling.
mannakiápa daytá ubíñg	that child always altercates.
mannakisugálda	they are gamblers.
mannakimísa ni ulitégko	my uncle always goes to Mass.
mannakidáwatda iti inumén	they always ask for water.
mannakisaludsúdda	they always ask questions.
mannakitabákoda	they always ask for tobacco.
mannakikaiddáda kenkuána	they always lie down with him.
mannakisinnúratda kaniák	they always write to me and vice versa.
mannakiammoammó	he always makes acquaintances.
mannakidumámagda	they always want information.
mannakipagdinnà kadakuáda	he also is always near them.

4. *Mañg* is *manañg*. Examples:

manañginanámakami a patináyon	we are always hopeful.
manañgrikná	she is tender, delicate.
ti mammadlés	the prophet.
dagití mammúyat	the watchers.
dagití mammáti	the faithful.
mammáut ni áma kaniák	my father always whips me.
manamátit ití kampána	he always rings the bell.
mannúratda	they are writers.
mananaóka	you speak very much.
mananákaw dagitá	those ones are thieves.
mananáitkayo	you are seamstresses.
dagití mañgñgálap	the fishermen.
mannañgán ni Ana	Ann always eats.
manañgñgaásida únay	they are very merciful.
isú ti mañgñgágas	he is the doctor.
mañgñganúp ni asáwak	my husband is a hunter.

14. SUBSTANTIVES INCLUDING VERBAL NOTIONS

I. Instead of using a preposition or some other construction to indicate: the instrument with which, the place where, the reason why, the person in whose behalf, the manner how, and the time when something is done, the Iloko has a series of prefixes and suffixes which add the afore-mentioned meaning of instrument, place, and so on, to the stem implying the action.

A. So, instead of saying: "She sews with a needle," which may be translated literally into: *agdáit ití dágum* the Iloko say ordinarily and more correctly: *pagdáitna ti dágum:* a needle is "the instrument with which she sews" (all in one word used as a predicate).

NOTE 11. This latter construction is ordinarily the more correct.

B. *a.* Instead of saying: "I sit on this stone," which may be translated literally into: *agtugáwak itóy batô*, the Iloko often say: *pagtugawák toy baté:* this stone is "the place where I sit."

b. Instead of saying: "Why does he weep?" which may be translated literally into: *ápay ñga agsáñgit*, the Iloko often say: *aniá ti pagsañgítanna:* "what is the reason why he weeps?"

c. Instead of saying: "He writes to me," which may be translated literally into: *agsúrat kaniák*, the Iloko may say: *pagsurátannak:* I am "the one to whom he writes."

NOTE 12. As may be seen by the above explanations, this construction is not always obligatory, and in some cases it is even preferable not to use it, because the meaning would not be clear; for example: *pagsañgítanna ti baláyna* may mean: he weeps in his house, and: he weeps on account of his house; consequently, it would be better to say: *agsáñgit idiáy baláyna*, and: *agsáñgit gapó ití baláyna*, respectively.

C. *a.* Instead of saying: "How does he write?" the Iloko say: *kasanó ti panagsúratna:* "how is his writing?"

b. Instead of saying: "When does he write?" the Iloko say: *kaanô ti panagsúratna:* "when is his writing?"

NOTE 13. This construction is very often obligatory.

II. These combinations are allowed with the most important prefixes of the adjectival voice. When the simple prefix allows them, so do also generally the complex prefixes derived from that simple prefix; so, for example: if the simple prefix *ag*, which allows these combinations (*pag*, *panag*, and others), is combined with other prefixes into *agin*, *agkara*, and others, the latter also allow these combinations of *ag* (*pagin*, *pagkara*, and others, *panagin*, *panagkara*, and others.[13]

A. The prefixes that indicate the instrument with which something is done are formed by changing the first consonant of the original verbal prefix into *p*, or by adding a *p* to the original prefix if it begins with a vowel. The forms of the past are the same as those of the present, except that the infix *in* is inserted after the initial *p* of the forms of the present.

The instrumental prefix derived from:

1. *Ag* is *pag* (past: *pinag*). Examples:

awán ti pagsúratko	I have no pen.
pagpúnasmi ti bádomi	we use our coat to wipe things.
nabasà dagiti pagsukátko	my clothes (to change) are wet.
daytá an-anák ti pagay-áyamyo	play with that doll.
lapáyag a pagdeñgñgég	ears to hear.
aniá ti aláek a pagsílawko	what light do I take?
dákes ti pagragádimi	our saw is bad.
awán ti pagkatámko	I have no plane.
aniá ti pagságadyo iti kuárto	with what do you sweep the room?
pinagkiñgkiñgda ti bató	they used a stone to play at hop-scotch.
aniá ti pagsapínko	what pants do I wear?
pinagbádona ti ginátañgko idí kalmán	he put on the coat I bought yesterday.
daytóy ti pagkàlapmi	we fish with this.
aniá ti pagkasdiáymo	with what do you do it that way?
awán ti pagginnúyodda	they have nothing with which to pull one another.

NOTE 14. When the initial open syllable of the stem is reduplicated, the prefix *pag* very often indicates:

[13] Notes on Iloko. Anthropos 23 (1928) 1037, 1038.

a. That something can be or has to be exchanged for what the stem implies. Examples:

pagpapágayko daytóy	I want to exchange this for rice.
pagpipirákmi dagiti ilákomi	we want money for our wares.

b. That something is used for what the stem implies as a substantive, and not for what it implies as a verb. Examples:

pagtutúdo ti páyoñgko	my umbrella is for the rain.
pagiinit ta páyoñgmo	your umbrella is for the sunshine.
pagliliñg-ét toy lúpot	this cloth is for the perspiration.
paglalammín ti ulésmi	our blanket is for the cold.

c. That one desires what the stem implies. Examples:

pagkikítak ti baláyna	I long to see his house.
pagdadáwatna daytá áso	he longs to ask for that dog.
pagdadánonmo ti Kabúgaw	you long to reach Kabugaw.
paggigíbusmi daytóy bagás	we want to finish this rice.

2. *Maka* is *paka* (past: *pinaka*). Example:

pakaoná dagiti masakbáyan	a presage of the future.

3. *Maki* is *paki* (past: *pinaki*). Examples:

asín ti pakikúyogmo	who is your companion?
pinakiálam daytá bagás	did you also take that rice?
ti pakiintúod	the question.

4. *Mañg* is *pañg* (past: *pinañg*). Examples:

aniá ti pañgatépyo iti balàyyo	with what do you roof your house?
díka pañgiddép ti danúm	do not use water to extinguish it.
ieú ti pinañgáwisko kenkuána	that is how I allured him.
bagás ti pañgaráyatda iti napañgláw	they help the poor with rice.
aniá ti pañganákko iti buniág	how can I be a godfather? (I have nothing.)
wásay ti pamútolna	he cuts off his head with an axe.
dakkél unáy a pinamaneknékda	a very great proof for them.
awán ti pinamáyadna	he had nothing to pay with.
aláem ti panáit a puráw	take white thread.
ti pañgsaksí	the testimony.
pañgaásim apó	please, Sir.
maysá a pañgñgárig	a parable.

NOTE 15. The prefix *pañg* or *pañgi* joined to names of towns, provinces, and the like, means that something is of use to the people of that town, province, and so on.[14] Examples:

pañglawág daytóy a kàyo	this timber is good for Laoag.
pañgagayán ti bagás	the rice is good for Cagayan.
pañgibañgár dagidiáy	those are good for the Bangar people.

[14] The Transitive Prefix *Mañg*. P. 9, Note. Unpublished.

B. The prefixes that indicate the place where, the reason why, and the person in whose behalf something is done, are formed in the same way as the instrumental prefix, but the suffix *an* is joined to the stem. The forms of the past are the same as those of the present, except that the initial *p* of the forms of the present is changed into *n*.

The combination derived from:

1. *Ag* is *pag . . . an* (past: *nag . . . an*). Examples:

adíno ti naguráyanyo kenkuána	where did you wait for him?
pagaládanda ti minuyoñgán	they fence the garden.
ditóy ti pagsubliánna	he comes back here.
intúgotna ti pagsarmíñgan	he took the looking-glass with him.
nadadáel ti pagsokogántayo	our mold is ruined.
aláem ti pagsiláwan	take the lamp.
aniá ti nagladiñgítam	why were you sad?
ti asók ti nagbaenák	I sneezed on account of the smoke.
kas pagarigan	for instance.
daytóy ti pagbabawiák	this is why I feel sorry.
asín ti pagapálanna	whom does he envy?
siák ti nagkamáñgam	you took shelter with me.
ti kaatiddágda ti naggiddiátanda	it was their length in which they differed.
sadíno ti pagariánna	where is his kingdom?
ti pagimbagánna ta nañgísit	it is a good thing that it is black.
daytóy ti pagdaksánna	this is the worst of it.
aniá ti nagbayagányo	where were you so long?
naglukaták ti kasañgsañgpét	I opened the door for the one who just arrived.
idiáy baláymi ti nagtarayánna	he ran to our house.
pagsagádanyo ti kuártomi	sweep our room.
idiáy ruár ti pagragadiányo	saw outside.
ditóy unég ti nagsintíkanda	they played at marbles inside here.
aniá ti nagsakitán ti asáwana	how did his wife get ill?
ti baybáy ti pagkalápantayo	let us fish in the sea.
aniá ti nagkastáanda	why did they do that?
paginnagáwanda ti bagás	they fight for the rice.
aniá ti paginnapálan da Mercéd	why do Mercy and her companion envy each other?
idiáy baláymi ti nagsusiksusíkanda	they disputed with one another in our house.
pagdamandamáganda ta nabayág a dída nagsasárak	they ask one another for news because it is a long time since they met.
adíno ti nagtinnuloñgtulóñganda	where did they help one another?
pagtagtagiammoán pay láeñg	it is still a doubtful matter.
sadíno ti naginbubulsekányo	where did you simulate blindness?
nagintutulcñgán ti ubíng ta nasadút	the boy simulated deafness because he is lazy.

ti pagindidiammoánna ta umaripapá	he simulates ignorance because he is shy.
paginsasaanánnmi ta kayátdaka a kitkitden	we simulate unwillingness because we want to see you.
anià ti pagkarasublián tay lúgan	why does that cart come back continually.
idiáy baláyyo ti pagkaraboóñgan ti piñggán	the plate gets cracks all the time in your house.
adíno ti pagsanultípanna	where does he blow a whistle with force?
aniá ti pagbanetbetánda	why do they strike with force?

2. *Maka* and *ma* is *paka . . . an* (past: *naka . . . an*). Examples:

nakauliák ti agdán	I climbed by the stairs.
sadín ti pakaulógam	where can you get down?
aniá ti díkayo nakaruáran	why did you not come out?
ti sakitko ti díak pakabasáan	I cannot read on account of my illness.
ti karayán ti dítay pakañggán	we cannot hear on account of the river.
pakaboóñgan ti ólo daytá	that is a matter for anxiety.
aniá ti dína pakabalinán	why cannot he do it?
isú ti pakapaneknekán	that is the proof.
sadíno ti nakatarayám	whither were you able to run?
nakasapúlak ditóy	I found it here.
aniá ti nakaariekánda	why did they sicken?
anía ti pakaturóganda	why do they become sleepy?
aniá ti pakainumánna manén	why does he want to drink again?
daytóy lakáy ti nakabasólak	I offended this old man.
aniá ti dína pakapagsañgítan	why can't he weep?
aniá ti saánda a nakapagsaoán	why couldn't they speak?
sadíno ti pakapagbaútam	where can you whip him?

3. *Maki* is *paki . . . an* (past: *naki . . . an*). Examples:

asín ti nakisaoám	to whom did you speak?
nakiasawáanna ni Juán	she married John.
aniá ti nakikuyóganyo kenkuána	why did you accompany him?
sadín ti pakiapáanna ken ína	where does she altercate with my mother?
isúda ti nakitallaóñgak	I joined them.
aniá ti nakitulágam kenkuána	why did you make a contract with him?
asíno ti pakianiányo	with whom do you harvest?
asíno ti nakidawátam ití tabáko	whom did you ask for tobacco?
sadíno ti pakisidaánda	where do they ask for viands?
isú ti pakikaiddaánna	he lies down with him.
isú ti nakikabbalayàk	I lived with him in the same house.
dítóy ti pakikatugawák ken kabsátko	here I sit down with my brother.

idiáy baláy ti nakibinniláñganda kenkuána	they counted it over with him in our house.
sadín ti pakibalanbalakádanda ken Juán	where do they give advice to John and get it?
pakipinnatenpategánmi kadakuáda ta agayanayátkami	we esteem them and we are esteemed by them because we love each other.
asín ti pakipagiddaám	with whom do you lie down?
sadíno ti nakipaginudoánna	where did he warm himself with them?
isú ti pakipaglak-ámanmi iti imbág	that is how we shall share in the good.
aniá ti nakipagsaritáanna	why did he talk with them?

4. *Mañg* is *pañg* . . . *an* (past: *nañg* . . . *an*). Examples:

sadín ti nañgaláam iti káyo	where did you take the wood?
adíno a balày ti nañgaldáwanda	in what house did they have lunch?
pañgababaán ti náganna	an abbreviation of his name.
awán ti pañgasáanyo	you have no hone.
sadín ti nañgroótanda	where did they gather grass?
ti karayán ti nañgipónanmi	we fished *ipon* in the river.
aniá ti namatiám kenkuána	why did you believe him?
ditóy ti pamantáyam iti págay	watch the rice here.
awán ti díak nañgsurátan	there is nobody to whom I did not write.
ti básolna ti panusáak kenkuána	I punish him for his faults.
ditóy ti panaritáanmi iti kayátmi	here we talk about what we like.
aniá ti nañgabílanda kenká	why did they beat you?
anià ti díka pañganán	why don't you eat?
aniá ti pañgapásanyo ditóy	why do you buy cotton here?

NOTE 16. When the original verb is formed with the simple infix *um*, ordinarily the combinations of some other adjectival prefix have to be used. However, there is a form of very little use, which it will be well to put down here: sometimes to indicate the place where, the reason why, the person in whose behalf something is done, the Iloko eliminate the infix *um* entirely and simply join the suffix *an* to the stem; this construction occurs mostly in the past form, which is made by the further addition of the infix *in*. In a few cases the infix *um* remains, and then the past form takes the infix *imm* instead of *in*. Examples:

aniá ti díka suñgbátan kaniák	why don't you answer me?
aniá ti sañgítanda	why do they weep?
aniá ti dída inulián	why did they not come up?
aniá ti saányo a tinugawán	why did you not sit down?
daytóy a baláy ti dinakkeláanda	they grew up in this house.
adíno ti linabagáanna	where did it become red?
ti sakítko ti kinapúyak	I became weak on account of my illness.
idiáy ti linukmegánmi	we became fat there.
daytóy ti inayák	I came for this reason.
mumumuláak daytóy	I plant this.

ti sumpókan	the place where one enters the bushes.
aniá ti imminumánna iti gamút	why did he drink poison?
isú ti balày a rimmuárak	that is the house from where I emerged.

C. The prefixes that indicate the manner how and the time when something is done have no special form for the past.

They are formed by changing:

1. *Ag* into *panag*. Examples:

intonanó ti panagsúratmo	when do you write?
kasanó ti panagdáitna	how does she sew?
intóno bigát ti panagdígusko	I shall take a bath to-morrow.
idí kalmán ti panagiddámi	we lay down yesterday.
nalaíñg ti panagsaóna	he talks fluently.
maipuón iti panagkarárag	by prayer.
nasayáat ti panagdániwna	she sings beautifully.
nalabés ti panaggaráwyo	you bustle too much.
kaanó ti panagságadda	when did they sweep it?
nakilló ti panagragádida	they saw crookedly.
kaanó ti panagsugálda	when did they gamble?
napalálo ti panagsúnay dagiti ubbiñg.	the children play too much at spinning tops.
itáy ti panagbádok	I put on my coat just now.
itattá pay láeñg ti panagsapín ti anákko	my son wore pants for the first time.
kaanó ti panagkuritátayo	when do we gather cuttles?
nalabés ti panagalimbàsagko	I have the nightmare awfully.
nalabés ti panaguyékna	he coughs very much.
kastá la únay ti panagánus ni tátañgmo	your father is so exceedingly patient.
intonanó ti panagmáestrana	when will she be a teacher?
itáy malém ti panagkastána	he did so this afternoon.
idí panagkabannuágko	when I was at the height of my strength.
asidég ti panagkabagída	they are near relatives.
ti panagkainnay-áyo	coaxing one another.
nakabutbutéñg ti panagginnúra dagitá	those ones hate one another terribly.
nakaay-ayát ti panagtuloñgtúloñgyo	your helping one another is lovable.
saán a rumbéñg ti panaglallalákina	it does not fit her to dress like a man.
kitáem ti panagsiwaráda	look how they scatter.
ipáritmo ti panagtagilákona	forbid him to sell things.
kaanó ti panagintutúleñg ti anákko	when did my son simulate deafness?
nakakatkatáwa ti panaginsasáñgityo	your pretended weeping is ridiculous.
nasipútam ti panagkarasublína	did you notice its coming back all the time?

deñggém ti panagsanultípna	hear him blow a whistle with force.
makaúma ti panagranetrét ta rikép	the creaking of that door is tiresome.
kasanó ti panagbabtóogna	how does he knock noisily?
di sumardéñg ti panagkanaltóogda	they do not stop crepitating.

2. The infix *um* into the prefix *i*, with reduplication of the first open syllable of the stem. Examples:

ità ti isasañgpétko	I came home now.
kaanó ti yuúlina	when did he ascend?
kasanó ti yuúlogmi	how do we descend?
kaanó ti ilatàona	when did he become man?
nadarás ti idadakkélna	he grew quickly.
naginayad ti itatakdéryon	how slowly you rise.
intonanó ti ilalábasna	when shall he pass?
idí kalmán ti yaáyda	they came yesterday.
intóno rabíi ti isusublímí	we shall come back this evening.
kasanó ti iseserrék dagití bábuy	how did the pigs enter?
itáy ti ibabáñgon ti anákko	my child arose just now.
napuótak ti iruruáryo	I noticed your coming out.

3. *Maka* and *ma* into *pannaka*. Examples:

kasanó ti pannakasañg-átmi	how can we ascend?
intonanó ti pannakaarámidmo iti baláy	when will you be able to make the house?
nalaús ti pannakabalínna	he has too much power.
intóno bigát ti pannakadánonmi	we shall be able to get there tomorrow.
napalálo ti pannakainúmko	I am very thirsty.
agduñgduñgsá gapó iti pannakatúrogna	he nods because he feels sleepy.
dakkél ti pannakabàsolna kaniák	he grievously offended me.
idí kalmán ti pannakalpásna	it was finished yesterday.
kaanó ti pannakaarámidna	when was it made?
itáy ti pannakasápulna	it was needed just now.
kasanó ti pannakaálana	how was it taken?
kaanó ti pannakapagkatáwana	when was he able to laugh?
kaanó ti dída pannakapagságad	when could they not sweep it?

4. *Maki* into *pannaki*. Examples:

kaanó ti pannakisaóm kenkuána	when did you talk with him?
intóno bigát ti pannakisarítak kenkuána	tomorrow I shall talk with him.
kasanó ti pannakikúyogko ken Tomás	how can I accompany Thomas?
naalás ti pannakiáñgawna kadagití balásañg	it is a shame to see him play with the girls.
idí pannakidáwatko kenká iti piràk	when I asked you for money.
makaúma ti pannakimamáda kadakamí	it is tiresome how they ask betel nuts from us.

narígat ti pannakigayyémyo kadakuáda	it is difficult for you to make friends with them.
nakaay-ayát ti pannakiamána ken gayyémko	it is lovable to see how he treats my friend as his father.
kaanó ti pannakikatugáwyo kaniák	when did you sit down with me?
idí napán a tawén ti pannakikabbaláymi kadagitá	last year we lived with those in the same house.
dakkél ti pannakiinnílíwmi	we long to see each other very much.
napaypaysó ti pannakipatenpatégko kadakuáda	my esteem for them and vice versa is true.
kaanó ti pannakipagkúyogtayo	when did we go together?
intonanó ti pannakipagtaróyna	when shall he run with them?

5. *Mañg* into *panañg*. Examples:

itáy it panañggátañgna iti kabáyo	he bought the horse just now.
awán ti panañginanàmamin	we have no more hope.
a las dos ti panañgaldáwmi	we had lunch at two o'clock.
kaanó ti panañgrabiiyo	when do you have supper?
intóno bigát ti panañgípontayo	tomorrow we shall fish *ipon*.
kaanó ti panañgróotmi	when do we gather grass?
kaanó ti panamarsuána iti lúbong	when did he create the world?
narambák ti panamonpónna ken amána	he buried his father solemnly.
idí panamakádam kaniák	when you took leave from me.
ti panamuggóna kadagiti sákada	his washing their feet.
naimbág ti panamagbagá	advice is good.
ti pammatégko kenká	my esteem for you.
kasanó ti pannubbótna kadakayó	how did he save you?
kasanó ti pannaráonko kadagitóy	how must I feed these?
ti pammáti	the faith.
ti pannaksí	the testimony.
kaanó ti pannañgánmi	when do we eat?
kastóy ti pañgñgeddéñgmo	do you decide this way?

NOTE 17. In a good many localities the Iloko pronounce *panag, pannaka, pannaki*, and *panañg* in a different way: they change the first *a* into *i*, and pronounce: *pinag, pinnaka, pinnaki*, and *pinañg*, respectively. This may be the reason why some authors consider these last forms as those of a past tense; but this is entirely wrong, as these prefixes have no special form for the past, and the Iloko who pronounce *pinag* for *panag*, for example, use the same for both tenses. The correct forms *pinag*, and so on, are the past forms either of the instrumental prefixes *pag*, and so on, which have been explained under II, A, or of the combinations *pag . . . en*, and others, which will be studied later. (Verbs implying order or permission, II, B.)

III. Verbal substantives corresponding more or less to the English ones are formed in exactly the same way as the preceding forms in *panag*, and so on, with the simple addition of the suffix *an* to the stem. However, the form in *i*, derived from

the infix *um*, does not allow this combination. These verbal substantives have no special form for the past. Examples:

itá ti panagodóñgan	now is the time to go to the town (on a feast day, for example).
intóno panagsursúran	when they will go from house to house.
kaanó ti panagburásan iti otóñg	when is the time of gathering cow-peas?
itóy a búlan ti panagtináan	this month is the time for dyeing.
aluádanyo ti panaggaíkan	take care in weeding.
ti panagdaítan	the sewing.
rumañg-áy ti panagmulàan	agriculture progresses.
ti panagtalónan	working the rice fields.
intóno bigát ti panagsimpáan	tomorrow is the time of putting the last touch.
ti panagtaraknán	breeding.
no addá áñgol isú ti pannakatayán dagití tattáo	when cholera reigns many men die (literally: it is the time of the death of men).
intóno bigát ti pannakibuyáan	tomorrow is the show.
naládaw ti panañganán	the meals are late.

BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

REVIEWS

An Ecological Glossary. Compiled by J. Richard Carpenter. Norman, Oklahoma, University of Oklahoma press, 1938. 306 pp., appendix. Price, $4.

This Glossary, in which definitions and concepts of ecological terms are stated in brief, clear, and concise language, is the most exhaustive and complete work on ecology that has ever been put in print. It was prepared primarily to reconcile the divergent meanings of many ecological terms, as given in past ecological literature, so as to conform with the recommendations of the Committee on Nomenclature of the Ecological Society of America.

While the author makes no pretense at calling the book complete, it includes nearly all technical ecological terms encountered in an exhaustive search of all available literature on the subject. Some 3,000 definitions of different terms used in ecology with various formulæ are lucidly presented in this treatise. For convenience the ecological terms have been arranged alphabetically.

Of special interest to students of ecology is the discussion on the "development of ecological nomenclature" which is a résumé of the history of ecology. A complete list of literature and a historical bibliography of all pertinent papers from 1895 to 1935, inclusive, dealing with terms and concepts of ecology, are included.

The appendix includes tables and maps showing different life zones of America and tables of biotic areas and equivalent terms used by present-day ecologists, which further simplify what the author desires to bring out in the main part of the book.

This book is a valuable reference not only to students who are interested in ecological literature but also to researchers in all biological sciences.—H. S. S.

Foods America Gave to the World. By A. Hyatt Verrill. Appendices in Collaboration with Otis W. Barrett. Boston, L. C. Page & Co., c1937. 289 pp., illus. Price, $3.

This book is a popular account of the known foods native or claimed to be native to the New World. The first twenty chapters are devoted to food plants, and the remaining two chapters to animal foods many of which are either little known or totally unknown in many parts of the world. Most of the important plants included are found and cultivated as major or minor crops in several countries, both in the East and in the West.

The first section includes a group of food plants from some species of the lowly weeds and ferns for their tender and nutritious shoots to the exalted family of the orchids from the pods or "beans" of which a vanilla scent for flavoring purposes can be extracted by highly complicated methods. Many of these plants grow in the wilderness of tropical America, and their edible products in most cases can be had for the picking. The author has taken time to trace briefly the origin and distribution of some of these plants outside of the Americas. He has especially noted down the rôle played by the American aborigines, the pre-Incas, the Incas, and the Aztecs, in the cultivation, improvement, and utilization of most of the better-known species. Each plant is adequately described and illustrated from the point of view of the layman. Many interesting and curious facts concerning them are recounted. The author has included helpful hints and precautions in the preparation of the edible products from otherwise unpalatable and poisonous plant materials.

In the last two chapters the author has enumerated several animals used as foods, a number of which are delicious to some people and far too odorous and repulsive to others. He deplores the reluctance and unwarranted prejudice of most people against many of these truly delicious foods. With increasing knowledge about them and the much improved storage and transportation facilities many of them are gradually being placed on the markets of the world.

A classified list of American foods, both plant and animal, with a brief note for each and in alphabetical arrangement under each class, is appended to the book. The book is very fascinating and enlightening throughout its pages. It should find a place in the public and school libraries.—Q. A. E.

Précis de Médecine Coloniale. By Ch. Joyeus and A. Sicé. Paris, Masson et Cie, 1937. 2d ed. 1,250 pp., illus. Price, 170 francs.

Following the former plan of grouping the exotic diseases according to the organs and systems involved, the second edition of the Precis is now available for practitioners interested in geographic medicine. An important innovation in this edition is the discussion of the epidemiology of infectious diseases immediately after the description of the causal agents.

The first part of the book describes the diseases of the digestive system and its adnexas. Starting with Engasgo's disease, common in the uncivilized interior parts of Brazil, which was recently studied and described by E. Vampré, the author gives a detailed and comprehensive presentation of the parasitic and diarrhæal diseases of the intestines, such as hymenolepis, ankylostomiasis, bilharziosis, distomatosis, amœbiasis, balantidiasis, giardiosis, cholera, and minor ailments. Bacillary and amœbic dysentery are described carefully and extensively. The exotic diseases of the liver and the other organs of the body are thoroughly dealt with.

The second part is devoted to the exotic febrile diseases. This general heading is divided into two subheadings, of which the first one comprises the exotic eruptive diseases, foremost among which are alastrim, smallpox, and the different form of typhus and exanthematous fevers, and the second includes the exotic icterogenous febrile diseases of which spirochætósis, icterohæmorhagica, billious hæmoglobinuria fever, malaria, recurrent fever, dengue, oroya and undulant fever, plague, kalaazar, chagas disease, and tularæmia, form a part.

The authors stresses the biology of the causative parasites, laboratory diagnosis, and external factors influencing the diseases. The most effective and up-to-date methods of treatment of each disease are described.

The third part is devoted to the general exotic diseases, among which are beriberi and poisoning and intoxication by venomous animals and insects.

The index at the end increases the usefulness and value of the book. The book is illustrated and contains references. It compares favorably with other publications on the same subjects and should prove very useful to the practitioner in the Philippines.—J. A.

An Enumeration of Plants Collected in Sumatra by W. N. and C. M. Bangham. By Elmer Drew Merrill. Contributions from the Arnold Arboretum of Harvard University, VIII. Jamaica Plains, Massachusetts, The Arnold Arboretum of Harvard University, 1934. 178 pp., illus. Price, $2.50.

To one interested in the Sumatran flora in particular, and in the Indo-Malayan in general, this paper is of great value. The enumeration is based on about 600 plants collected by Walter N. and Catherine M. Bangham in December, 1931, and in January and February, 1932, in northern Sumatra. The enumeration also included about 70 numbers of Orchidaceæ in the herbarium of Prof. Oakes Ames and 70 herbaceous plants presented by the Arnold Arboretum to the Gray Herbarium. The Bangham collection includes about 484 species, 105 of which are known only from Sumatra; 34 only from Java and Sumatra; 16 only from the Malay Peninsula and Sumatra; 6 only from Borneo and Sumatra; 10 only from the Malay Peninsula, Java and Sumatra; 110 only from Java, Borneo, and Sumatra; 9 only from the Malay Peninsula, Borneo, and Sumatra; and 15 only from the Malay Peninsula, Java, Borneo, and Sumatra. Thirteen additional species also have this last restricted range, except that they also extend to the Philippines. Nearly 217 of the 484 species are confined thus to the Sunda Islands and the Malay Peninsula, while most of the other species are much more widely distributed. In general the collections indicate an essential unity of the flora of the Sunda Islands (Java, Borneo, and Sumatra) and that of the Malay Peninsula. It is of interest to note that 25 of the species of the Bangham collection represent Asiatic types some of which are known outside of continental Asia only from Sumatra, and none of which are known from the Malay Peninsula, Borneo, or Java.

The collections represent 6 families of ferns, 2 families of gymnosperms, 11 families of the monocotyledons, and 80 families of dicotyledons. Thirty-eight are new species, the types being deposited in the herbarium of the Arnold Arboretum, with isotypes of most of them in the herbarium of the New York Botanical Garden.

Various changes in nomenclature have been found unavoidable by Doctor Merril. One of these is the adoption of the generic name *Poikilospermum* Zippell (1864) for *Conocephalus* Blume (1825), not of Necker (1790) as validated by Dumortier (1822), in the family Moraceæ, under which various new combinations were made.

The enumeration includes 38 new species distributed as follows: Ericaceæ, 7; Orchidacæ and Araliaceæ, 5 each; Anonaceæ, Myrcinaceæ, Primulaceæ, Gesneriaceæ, and Rubiaceæ, 2 each; and Moraceæ, Berberidaceæ, Saxifragaceæ, Rosaceæ, Meliaceæ, Euphorbiaceæ, Celastraceæ, Guttiferæ, Passifloraceæ, Apocynaceæ, and Labiatæ, 1 each. The species under the family Loranthaceæ were determined by Dr. B. H. Danser, of Groningen, Holland.

This contribution contains 14 plates. It is a valuable addition to the references in systematic botany.—J. B. J.

Sex Satisfaction and Happy Marriage. By the Reverend Alfred Henry Tyrer. Foreword by Robert L. Dickerson. New York, Emerson books, Inc., 1938. 160 pp., illus. Price, $2.

This book is a splendid piece of work, complete in every detail yet very concise in giving accurate information regarding sexual knowledge essential to normal happy marriage. While the author makes no pretense to embody in the book everything concerning sexual relationship and marriage, he has succeeded in presenting an unusual amount of well correlated data in a lucid manner understandable to the layman. In short, this book is a work that is scientific, comprehensive, and serious, yet human, brief, and simple.

In the first part the author presents factual details about the anatomy and physiology of the human sex organs. How and where babies are formed, and the course of pregnancy with emphasis on prenatal care, most particularly the preventive importance of intercourse, are briefly and interestingly dealt with. Abortion and birth control with their dangers are also succinctly but unsparingly discussed. Then simply, without malice but thoroughly, he discusses the behavior aspects of the "love play" and the "first nights," especially on the preventive value of the rapture of the marriage bond. Finally he touched on "many things" to which sex and marriage are closely and dependably related.

Dealing with most intimate and at the same time the most sacred relationship of the married couple, this book gives a straightforward approach to the subject. Even those people who consider taboo all sex impulses, manifestations, and consummations, will find the book wholesome, unprejudicial, and very beneficial to the body, to the mind, and to the soul. The book is worth a place on everyone's bookshelf.—S. A. E.

The Cacao Industry of Trinidad. Some Economic Aspects. Series II, III, and IV. By C. Y. Shephard. Trinidad, Government printing office, 1936–37. 30+101 pp., illus.

General interest in the cacao industry of Trinidad and its economic aspects should increase as a result of the publication, in 1936 and 1937, of a series of three interesting articles; namely, a financial survey of estates during the seven years 1923–1930, an examination of the effects of soil type and age on yield, and recommendations for improving the efficiency of estates, all written by C. Y. Shephard, Carnegie Professor of Economics, Imperial College of Tropical Agriculture.

The author studied carefully the financial records of numerous cacao estates in all the principal cacao-growing districts in Trinidad and the results of the examination of fields of more important soil types with the object of ascertaining the principal factors responsible for the success and failure of these estates.

The author discusses the following subjects: Financial organization and management of estates, diversification of crops, housing, elimination of unprofitable cacao fields, selection of fields for treatment, advantages and disadvantages of replanting cacao fields, recognition and replacing of poor bearers, multiple-stemmed trees, types of planting material, care of supplies, method of rehabilitation, choice of fertilizers, subsequent treatment of fields, diseases and pests, and regeneration.

The most important factors that determine yield and profits in Trinidad cacao estates are unsuitable soil and the increasing age of the cacao trees. Under the conditions in which the estates were found, the outstanding suggestion made is to rehabilitate the cacao estates by a systematic and carefully designed plan with special attention to the elimination of unprofitable fields and concentration of effort on fields worthy of retention.

The author presents clearly and concisely to the students of the cacao industry various factors affecting the yield and profits and the means of improving the cacao estates. The most notable feature is the wealth of data and illustrations together with their unbiased interpretation.—P. A. D.

Sprinkle's Conversion Formulas. By Leland W. Sprinkle. Philadelphia, P. Blakiston's Sons & Co., Inc. 1938. 122 pp. Price, $1.25.

The conversion formulas in this little book are simple operations for changing one unit into another. As a whole the book

consists of condensed tables suitable for the everyday needs of professionals, businessmen, and housewives. To eliminate the personal equation as much as possible, the author uses only one simple process—multiplication. In this manner even school children who understand the four fundamentals of arithmetic can use the book to good advantage.

A busy person will find the tables helpful. With the help of this reference book students of chemistry, physics, and engineering will save time in the solution of problems. The alphabetical arrangement of units contributes greatly to the ease with which desired information can be found in this book.

—M. P. R.

Atlass of Hæmatology. By Edwin E. Osgood and Clarice M. Ashworth. San Francisco, J. W. Stacey, Inc., c1937. 255 pp., frontis., illus. Price, $10.

The profuse well-drawn illustrations in the text, showing vividly the cell structures, will never fail to make a lasting impression of the subject matter upon the mind of the reader. The systematic and concise way the structures and hæmatologic conditions are described, with close and frequent references to figures and tables, make the understanding and assimilation of hæmatologic facts quite simple. The text will be doubly useful to Filipino workers inasmuch as the illustrations are drawn from Wright-stained preparations, the stain more universally used in this country.

This atlas contains a classified list of references on hæmatology.—W. L.

The Principles of Cane Sugar Manufacture (together with a description of the machinery). By J. G. Davies. London, Norman Rodger, 1938. 144 pp., front., illus. Price, prepaid, 11s.

Although written for the nontechnical reader who possesses very little or no knowledge of cane-sugar manufacture, the book should have a place in the reference shelf of technical men as a guide in writing papers for laymen.

The author has endeavored to present the main branches of this great industry in a manner intelligible and interesting to the reader. This purpose was accomplished by the inclusion of flowsheets, graphic diagrams, and plates. The exposition is so clear and simple that the book will serve to help popularize science and industry.

The subjects discussed are: Juice extraction, steam generation, screening and clarification, subsidation (settling), filtration,

multiple-effect evaporation, crystallization, separation, processes for the manufacture of direct consumption sugars, fancy molasses, transport, the utilization of factory byproducts, and chemical control. The author mentioned new apparatus for sugar boiling but he failed to note the use of double helix crystallizers which are common in Philippine sugar centrals. To those looking for a general idea of the sugar industry, this book should be very helpful.—G. O. O.

The Soviet Food Industry; By A. I. Mikoyan. Moscow, Coöperative publishing society of foreign workers in the U. S. S. R., 1936. 77 pp. Price, 50 kopeks.

The solution of the food problem was regarded by the Soviet leaders as one of the most important tasks of National economic planning. While during the First Five Year Plan this task was left unsolved in favor of the more basic tasks of building the heavy industries and of solving the agrarian problem, with the Second Five Year Plan light industries and the food industries became all-important. Progress in these industries in comparison with both old Russia and foreign countries is reviewed in this book in terms of statistics.

Due mainly to the backward feudal character of her economy, tsarist Russia had no food industry except small-scale manufactures of vodka, sugar, and tobacco. By 1936, in less than 20 years after the Russian revolution, Soviet Russia has become the greatest producer of sugar in the world, having produced around 2.2 million tons, as compared to around 1.5 million tons by the United States exclusive of colonies. The Russian sugar refineries are linked with the sugar-beet fields by 2,300 kilometers of railway lines, and the Russians are now drying beet offal for cattle feed.

The Soviet Union holds second place in the fishing industry, second only to Japan and outstripping the United States, Great Britain, and Norway. She has 3,150 fishing vessels, with an aggregate of 230,000 H. P., and 26 cold storage plants. She has 55 fish canneries, with a total capacity of 252 million tins per year, and 28 plants producing fish oil and fish flour for cattle feed.

In the production of canned meat, fruits, vegetables, and milk, the Soviet Union has also improved tremendously, having produced in 1936 around 216 million tins of canned meat, 100 million tins of canned vegetables, 298 million tins of canned fruits, and 25.4 million tins of canned milk.

In animal industry rapid strides have also been made. Around 650,000 tons of meat, 170,000 tons of sausages, 285,000 tons of milk, and 193,000 tons of butter from 403 well-equipped mechanized butter factories, have been produced, although the production of cheese is still low.

As to vegetable oils, the Soviet Union's program for 1936 was around 475,000 tons, a low figure compared to the world's production. Production in this field is expected to improve after scientific improvements in the production of tea, citrus fruits, tobacco, essential oils, alcohol, rubber, and the like have been made. It is interesting to note that around 42,000 tons of synthetic rubber from alcohol and 5 million decaliters of 99.8 proof alcohol for airplanes and automobiles were produced in 1936, as factors in self-sufficiency.

Considering that all the basic means of production in the Soviet Union are socialized, these rapid strides not only in the basic industries but also in the light and food industries can mean only a higher standard of living for all people of that country.

This pamphlet summarizes much information of value to any one interested in the solution of the food problem.—V. G. L.

Floral Morphology; a New Outlook with Special Reference to the Interpretation of the Gynæceum. V. 1. By E. R. Saunders. Cambridge, W. Heffer & Sons, Ltd., 1937. 132 pp., illus. Price, 3s 6d.

The present volume is a résumé of a series of papers by the author on the subject of carpel morphology of angiosperms. It is intended primarily as a guide to the study of types for laboratory work. It contains an exposition of the general principles underlying the floral arrangement and data directly or indirectly relevant to his viewpoint, leaving the reader to look for other information from existing works on systematic botany. Thirty-nine families are considered. In each family the general characters of the flower and one or more 'illustrative' types are examined in detail.

Attention is mainly focused on the features and interrelations of floral members so as to give the reader a correct interpretation of the floral ground plan. A satisfactory solution of the problems of floral morphology, as given in this book, is not to be expected unless evidence of external appearance is supplemented by that of the internal, specially where union between floral members, whether of the same or different whorls usually peculiar to gynæceum, takes place. Particular families were

selected for consideration and examination from the standpoint of the problems presented by the particular types of construction, apart from systematic relationship, although so far as it could conveniently be done, groups of related families have been treated together. The book would have been more interesting to students of phylogeny if more extensive discussions on this subject had been added to the text.—J. B. J.

RECEIVED

CABLE, DONALD E. 1937 Bibliography of rubber literature (excluding patents). New York, The Rubber age, 1938. 128 pp.

DAVIES, J. G. The Principles of cane sugar manufacture (together with a description of the machinery). London, Norman Rodger, 1938. 144 pp., front., illus. Price, prepaid, 11s.

Rubber Research Institute of Malaya. Rubber-growing: elementary principles and practice. Compiled and prepared for publication by A. Moore from material supplied by members of the staff of the institute and in consultation with the Department of Agriculture, S. S. & F. M. S. Kuala Lumpur, F. M. S., Published by the Rubber research institute of Malaya and printed by Kyle, Palmer & co., ltd., January 1938. 82 pp., illus. Price, 50 cents.